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East Europe Report

SCIENCE AND TECHNOLOGY

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EAST EUROPE REPORT

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HUNGARY

PRODUCTIVE WORK AT ACADEMY INSTITUTE OF EXPERIMENTAL MEDICINE

Budapest NEPSZABADSAG in Hungarian 29 Nov 84 p 5

[Excerpts] At Two "Frontiers"

The current director of KOKI [Research Institute of Experimental Medicine] is Ervin Stark, academician, who had been a coworker and deputy of Istvan Rusznyak at the same institute. Jointly with academicians Issekutz and Toro, they started the investigations which continued to characterize the institute to this day.

Stark provides a concise summary of the past as well as the present. Three departments are active at the institute: pathobiology, pharmacology and cell biology or rather morphology. The direction of the activities and investigations at the institute could be characterized as neuroendocrinological and neuropharmacological research. In other words, we are studying the role of the nervous system in the hormonal balance of the human organism and how this can be influenced by drugs. Thus we are working at two frontiers of medical science. On the one hand, we are studying the basic laws of the organism's function at a point bordering on physiology and even biochemistry, on the other hand, our work is associated with the production of drugs directly involved in therapy.

After this brief summary let us examine more closely some aspects of the work done at the KOKI. In order to understand it, one must know that only 160 people are working at the 20-year old institute. Of these 45 are graduate research scientists and there are 50 assistants. The investigators consist of physicians, biologists and chemists because these three types of degrees are indispensable today in basic medical research. However, technical experts in instrument maintenance and development, mathematicians and physicists are also employed.

This being an institute of basic research, the first report we get will be on results associated with nervous systemic function, of course. First of all, about our discovery associated with CRF-neurons which no one wanted to believe for a long time: nine internationally recognized research institutes had endorsed a view contrary to the KOKI investigators' but, after a 6 year debate, our results became generally accepted today and their validity was also confirmed by studies conducted elsewhere.

The discovery is not a simple one but the head of the research group, Dr Gabor Makara, chief scientific collaborator, provides a clear summary:

"The adrenal cortex plays an important role in the function of the organism, it can alter the entire metabolism. On the other hand, ACTH, a hormone produced by the pituitary gland, plays an important role in regulating the secretion of its hormones. Investigators have long been intrigued by the question of what regulates ACTH secretion. Under the leadership of Academician Start, we also were studying this problem. It had been presumed since the mid-1950's that ACTH is a cerebral hormone which functions under a 3-"level" ("cascade") hormonal regulation. At the starting point of these 3 "levels," the brain secretes 10-12 grams of a hormone (one millionth of one millionth of a gram)."

This hypothetical active compound was named CRF but it was not exactly known what type of material it is. On the other hand, there was a generally accepted theory that the CRF is produced in the area nearest to the pituitary gland. Our discovery started with the finding that a related experiment "did not agree". On making a cut around this area, regulation ceased at our laboratory while the same thing failed to happen at other laboratories. We had spent a year searching for the error. Why would the "cascade" be retained in spite of the cut around the area? Finally it was ascertained that if a few microscopic fibers remained intact the system functioned. On the other hand, if nothing remained intact the system ceased to function. This demonstrated that the ability of the system to react was dependent on the integrity of the fibers. To explain this finding a new theory had to be found. A highly sensitive method was worked out to confirm the theory. With its help we did indeed find the substance and in a previously unsuspected part of the brain! A little later, CRF was discovered by others who confirmed that it is formed in the designated area.

First Time on Earth

The scientist refrains from evaluating their own achievement but other experts declare it an indisputable fact that it created quite a stir and recognition that the KOKI research group, in collaboration with British investigators, was the first in the world to recognize the location and path of the neurons which produce the CRF hormone. This had clarified a delicate detail in the function of the organism--but this recognition also provided the possibility of recognizing the pathomechanism of ACTH-deficiency syndromes. This fact is a good indication that basic research can never (or not for long) be isolated from the practical application of knowledge.

The investigations conducted at KOKI are aimed at elucidating the function of the central nervous system. A few years ago, one of the findings in this area created such a sensation that--even if they fail to mention it in the course of a lecture at some international conference--there is always someone referring to this finding and asking about it. Dr Vizi, who is in charge of this research, gives a brief description:

"It is characteristic of nervous systemic function that the contact between

neurons (elemental "building blocks" of the nervous system) is maintained through chemical compounds, the so-called neurotransmitters. According to the still generally accepted "orthodox" theories, this compound is released by the end apparatuses at the tip of the neurons and, traveling through a very short distance, it reaches the next neuron thereby transmitting information. Our discovery was that a neurotransmitter can be released not only from the end apparatuses but from the entire surface of nerve cells even if there is no close connection between two neurons. This provides much greater connection possibilities for nerve cells to interact. Let me illustrate the two types of connection by using an example from technology: the "conventional" impulse transmission is like a phone transmission where information can only be transmitted from a certain place to a certain other place. In contrast, the impulse transmission discovered by us is like the radio: the information is released from a certain place and everyone can receive it who has an appropriate receiver. There are no "wires." (By the way, this is discussed in the monograph by Dr Vizi which is already being advertised in the United States: it was very recently published by the most demanding publisher.) Its significance is that, in the case of many diseases--for instance Parkinson's disease, depression---errors in impulse transmission may play a role. This recognition thus provides some possibilities for pharmaceutical research to develop compounds, drugs imitating endogenous (produced within the organism) substances, or inhibiting their release or their effects."

Telling Numbers

The internationally accepted method for evaluating such basic research work and results is to determine the number of articles appearing and the number of references made to such articles. This is not always precisely characteristic with respect to a single investigator but it does characterize rather well the results with respect to an institute and over a longer time span. Therefore it is worth while to cite a few numbers: the number of articles appearing from KOKI was 42 (plus 7 in Hungarian) in 1980, 42 (10) in 1981, 46 (4) in 1982 and 50 (9) in 1983. The number of references was 609 in 1981, 801 in 1982 and more than 900 in 1983. This indicates that the international scientific community is paying attention, moveover, values the efforts of the institute. The so-called impact number, characterizing the importance of the places of publication, was 58.3 in 1981, 78.1 in 1982 and 86.2 in 1983.

Thus it is understandable that the KOKI did not respond when not long ago, in a Hungarian weekly discussing medical research and indisputably referring to this institute, someone wrote: "For decades, not a single sound idea came forth from the towering buildings of basic research." In contrast to such summary criticism, the judgement of the international scientific community, also expressable in numbers, has confirmed that the KOKI is proceeding on the right path; no one denies, of course, that it could also proceed with longer or more rapid steps, but this depends on many other factors in addition to effort. It can be suspected what these other factors are. We can mention here the other two main groups of research at the KOKI: the efforts related to pharmaceutical research and production. These were summarized by Dr Vizi, deputy director of research, in the following.

"Within the past 3 to 5 years, the institute had no results in applied research research which would have had a significant effect on certain branches of the national economy. However, it produced several results important to both health care and the pharamaceutical industry, and were used by these. For instance, we developed the prostaglandin (test) kit which was bought by the Isotope Institute of the Hungarian Academy of Sciences and was successfully marketed by them both on the domestic and foreign markets. Or another, the group of potential antieplieptic compounds, developed about 10 years ago at our institute, had been examined by a work group of NIH (research center and also state guidance and overseer agency) in the United States which qualified as a "potential antiepileptic drug" the compound also considered best by us; it requested a larger amount of it for further studies, and enterprises from several developed capitalist countries are also interested in the patented compound. In cooperation with Chinoin and the group directed by Csaba Szantay, academician, at the Central Chemical Research Institute of the Academy, we are working on the development of a compound with antidepressant effect. But also related to the basic research activities at the institute are some results which play an important role in health care, for instance, used for diagnostic purposes such as the case mentioned (reported in ORVOSI HETILAP)."

"There has already been talk about joint foreign ventures and work carried out abroad. This is also an indicator of the international scientific standing of an institute. Would you say something about it in conclusion?"

"The readiness of foreign colleagues for joint ventures indeed expresses a type of evaluation of our work and we are--I feel justly--proud of it. I could not list the number of institutes we are in cooperation with from the United States to the Soviet Union (Moscow, Lenigrad, Jerevan), from England to Czechoslovakia (Pozsony [Bratislava]). I should rather refer to the fact that, on the one hand, there is increasing interest in working at our institute as a visiting scientist. The KOKI was visited for purposes of rather extended research studies by 9 scientists in 1981, 43 in 1982 and 50 in 1983.

2473
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HUNGARY

ROUNDUP OF DEVELOPMENTS IN BIOTECHNOLOGY PUBLISHED

Budapest MUSZAKI ELET in Hungarian 22 Dec 84 p 13

[Article by Dr Ferenc Marffy, deputy department head of the Protein and Biotechnological Bureau of OMFB [National Technical Development Committee]]

[Text] The pharmaceutical industry and the food industry are the most traditional fields of biotechnology. As early as between the two world wars the Hungarian pharmaceutical industry began producing medicinal compounds obtained from animal organs (Chinoin, Phamaceutical Factory of Kobanya) and from plants (Alkaloida, United Pharmaceutical and Nutriment Factory, Pharmaceutical Factory of Kobanya), followed later by yeast processing. The basic steps of fermentation technology had already been developed by the late 1940's but fermentation research was given great impetus through the establishment of the Pharmaceutical Research Institute. In the wake of successful development (Chinoin, Pharmaceutical Factory of Kobanya, Biogal, Phylaxia, Human Institute of Vaccine Production), there was rapid progress in industrial implementation.

Both in research and industrial production, outstanding results were achieved in certain areas and the Hungarian pharmaceutical industry appeared among the first, even on a global scale, with a few products (vitamin B_{12}, steroids).

In the food industry, fermentation production and research go back to the time before the liberation (the first alcohol factory was established in 1842, vinegar factory in 1870, lactic acid factory in 1934 and the first acetic acid-butanol factory in 1936) although both production and research started on a rapid course of development after the 1960's.

A few technologies were set up during the last decade (sugar production with immobilized enzymes from corn, enzymatic method of beer production, etc) which can be called outstanding achievements also by European standards. Based on the results of basic research over several decades, the practice of plant cell and tissue culture and isolation of the mutant cell lines were started recently. Over the past few years, a number of theoretical and experimental bodies of knowledge have accumulated abroad which can insure revolutionary changes in the traditional biotechnological procedures and promise a highly significant breakthrough in the production of goods belonging in the areas mentioned, their rentability and the utilization of alternative sources of raw material.

There has been a rapid development world wide in research aimed at exploiting and utilizing the possibilities provided by the new biotechnology, in the fields of medicine, food supply, energy and the supply of industrial materials. Although certain initial successes have already been achieved, also in Hungary, it is the projection of international experts that the realization of decisively significant results in the economic context will come after 1990.

Gene Manipulation

In Hungary, the gene manipulation technique was first used (1974) at the Biology Center in Szeged of MTA [Hungarian Academy of Sciences]. They have continued to conduct the largest volume of such type of basic research. Gene manipulation research with lesser intensity is being conducted at the National Frederic Joliot-Curie Research Institute of Radiation Biology and Radiation Hygiene, at Semmelweis Medical University, Institute of Microbiology, at DOTE [Medical University of Debrecen], Institute of Biology and at JATE [Jozsef Attila University], Department of Genetics. In addition to the results of basic research employing this technique, subsequent research is in progress at SZBK [Biology Center in Szeged] on the manufacture of human insulin by bacteria.

At SZBK, they also started work (1980) on the chemical synthesis of DNA--following others for the time being--preparation of the vasopressin-coding DNA segment being the first application.

The first steps toward the industrial application of gene manipulation are currently being taken by the Pharmaceutical Factory of Kobanya, Chinoin, Biogal and the Pharmaceutical Research Institute. In January 1981, the National Genetic Engineering Research Network was established by the Department of Biology and Medical Sciences of MTA to coordinate this type of domestic research.

Cell and Protoplast Fusion

In the area of protoplast fusion research, results outstanding on an international scale were achieved in our country. The fusion of fungus protoplasts was carried out at the Department of Microbiology of JATE and of bacterium protoplasts at SZBK, both for the first time globally. Important results were achieved also in the field of plant protoplast fusion. Part of the research results are currently being introduced to industry (Pharmaceutical Research Institute, Biogal, Pharmaceutical Factory of Kobanya, Chinoin). The hybridoma technique was also first used in Hungary at SZBK and they have produced monoclonal antibodies at the laboratory level. In recent years, the technique had also been introduced and is being successfully used at certain departments of ELTE [Eotvos Lorant University], DOTE and POTE [Medical University of Pecs]. The complete lack of industrial capacity for the fermentation of animal cells is, for the time being, a severe hindrance to the industrial application of the technique.

Bioengineering

The field of science investigating the engineering part of biotechnology is called bioengineering. In this field, the fermentor-computer connection built

at the Technical University of Budapest and Biogal, and the research and teaching activity directed toward the instrumentation, guidance, and technical and economic optimization of the fermentation process can be looked upon as internationally acknowledged achievements. The pharmaceutical factories had also made the first steps toward establishing experimental shops in the interest of modern research and of adopting the results of gene manipulation.

The traditional background in industrial biotechnology is available for economic utilization but modernization of the experimental and production units is indispensable. Furthermore, in the interest of industrial application of the new procedures, the formation of new operational units and experimental shops is indispensable.

Tasks, Priorities

In the interest of our earliest catching up with world standards, the domestic foundation of research and development must be strengthened. Industry must be prepared to receive the results. The necessary worker supply must be assured for the field of biotechnology.

--It is important that microbiological research in physiology be strengthened because this is a neglected area in our country and also because such knowledge (regulation, deficient mutants) enables the regulation of fermentation which in turn insures high productivity.

--At present, it is clearly visible that an increasing number of
sensors
large instruments
computers
are being attached to fermentors, therefore, increased efforts must be made to insure adequate instrumentation and the establishment of fermentor regulation.

--Mathematical modelling and optimization of the fermentation processes can also be viewed as an important priority. This could significantly increase the rentability of the fermentation process.

--The modern separation technologies (membrane, biospecific, gel filtration, chromatographic separation) must be more widely applied. These processes should best be guided by means of microprocessors.

--Increasing the scale is a neglected area of biotechnology. Studying its problems is one of the basic requirements of technological advancement.

--In environmental protection, in studies involving microorganisms playing a role in the biological methods of waste water purification, three areas appear very promising:

isolation of microbes which decompose the appropriate waste water components and their "improvement" by means of gene splicing;

the "composition" of mixed cultures capable of decomposing various waste waters (these ought to be produced and marketed in the form of starter cultures);

the production of immobilized pure cultures and mixed cultures for this purpose.

By domestically manufacturing part of the biotechnological installations and instruments, we could relieve the burdens of foreign currency imports and, at the same time, we would expand the choices offered by the Hungarian instrument and machine industry with products also marketable abroad.. Attaching large laboratory instruments (ion selective electrodes, counterflow, etc) to fermentors would not only enhance the marketability of the instruments mentioned but it would also promote the sale of complete systems.

It must be stressed that biotechnology cannot be sharply separated from the complex activities conducted in the fields mentioned (pharmaceutical industry, plant-protective chemicals industry, agriculture, food industry). The complexity of research and the situation developed in the course of previous development must be taken into account.

Although the rapid advancement in gene manipulation techniques and their expanding use open up a broad perspective for a considerable part of the biologically active materials (primarily materials of a peptide/protein nature), before their industrial-scale production it must be stressed that the by now nearly classical methods of chemical synthesis, electrosynthesis and isolation from natural sources cannot as yet be dispensed with in biotechnology.

The elucidation of the relationship between effect and structure will still belong under "classical chemical synthesis" in the near future. Therefore, biotechnology and the use of classical methods in the study of biologically active materials will continue to be the two organically related and mutually complementary research trends, and their use is possible only in this context.

At the level of basic research, the gene manipulation techniques can never be without the independent knowledge, originating from other sources, concerning the structure and biological properties of the peptide to be produced by biotechnological means. It is obvious that such information can be arrived at by isolating an unknown peptide and its structural and biological description. Therefore, a continuation and expansion of the work toward the isolation of the new, biologically active peptides and proteins is necessary. Although, during the past decade, domestic attainments were outstanding in this area (the ACTH-sequence correction, elucidation of the structures of swine and human lipotropins and of beta-endorphin at the Pharmaceutical Research Institute), the current investigations are hampered by organizational factors and technical deficiencies.

Training of Specialists

In addition to eliminating the technical deficiencies, ensuring the supply of specialists is a foremost task. The universities and SZBK provide excellent preparation for theoretical and laboratory-level activities. Chemicals,

laboratory equipment and instrument supply are indispensable requisites for maintaining the standards. The Department of Agricultural Chemical Technology of BME [Technical University of Budapest] has two decades of experience in training engineers for the field of biotechnology. Since this type of research and training in the country is available only at BME, (a very up-to-date biologist-engineer training has been going on for a few years in cooperation between BME and ELTE), this is another reason why we rely on the expansion of training and advanced training within this institution.

In early 1985, the postgraduate training of biotechnological engineers will be started.

Promoting the basic research activities at the two biological centers (Szeged and Budapest) will result in their being able to remain near the international forefront, and they will also be able to increase the level of education for genetic and biotechnological engineers. In the framework of the OKKFT [National Central Medium Term Development Plan] A/16 program, the establishment of a modern experimental fermentation and processing plant is being started at BME. By developing the experimental plant, this cooperation can be increased and expanded to include other institutes (for example, the Agrarian University of Godollo) and factories, as well as agricultural production units.

2473
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POLAND

ANALYSIS OF BALTIC COAST URANIUM-BEARING MINERALS SUMMARIZED

Warsaw KWARTALNIK GEOLOGICZNY in English No 2, 1984 p 362

[Article by Elzbieta Baraja: "Uranium Minerals in Traissic Rocks in the Peri-Baltic Syneclise"]

[Text] The paper presents results of studies on uranium minerals in Buntsandstein and Middle Traissic rocks from the vicinities of Krynica Morska, the Peri-Baltic Syneclise (Fig. 1). The hitherto obtained data made it possible to find three uranium-bearing horizons in that area.

The lower uranium-bearing horizon (III) is situated in the section of Lidzbark Formation (Middle Buntsandstein), being related to gray and green claystones. Content of uranium in these claystones is low and this horizon was not covered by the studies on uranium minerals.

The middle uranium-bearing horizon (II) is situated at the base of Elblag Formation (Upper Buntsandstein). The horizon, characterized by the richest uranium mineralization, is related to fine- and course-grained sediments, gray and gray-green in colour. The studies involving microscopic analyses in transmittent and reflected light, microradiographic analysis (Tables 1-2) and X-ray-structural ones on the separated below 0.06 mm fraction of sandstones, made it possible to identify uranium minerals: coffinite and nasturan.

The same minerals as above have also been identified in samples of gray fine-grained sandstones of the upper uranium-bearing horizon (I). That horizon is stratigraphically related to Upper Buntsandstein or Middle Triassic rocks.

Final part of the paper presents an attempt to characterize geochemical associations and mineral parageneses of the studied strata.

CSO: 2020/57

POLAND

TECHNICAL DATA ON NEW ENGINEERING PRODUCTS

Warsaw POLISH ENGINEERING in English No 4, 1984 pp 29-33

[Text] The 4501 Echosounder

The 4501 is a vertical navigational echosounder with depth measurement range from 5 to 200 m, with minimum range of 20 cm.

It is suitable for the measurement of shallow water reservoirs: rivers, lakes, channels and pools, as well as harbour basins, the precision of inducations being 3 percent. It may be used as the second echosounder on ships of large size, to facilitate navigation in channels, ports and difficult straits. The 4501 echosaunder may also be used for defining the profiles of river and water reservoir bottom.

It allows a single-point measurement, in small ships, two-point (nose, stern) or four-point (nose, stern, port and starboard) measurement on large ships.

New Grades of Permanently Magnetic Materials of the ALNICO Type

At the Baildon Metallurgical Works production has been started of four new grades of permanent magnets with column macrostructure, and also permanent magnets with equiaxial grain structure. These magnets are characterized with residual magnetism 61.0-1.05 T or 0.70-0.80 T, correlation force 120-130 kA/m or 150-170 kA/m, and maximum magnetic energy 80-85 kJ/m^3 and 40-45 kJ/m^3.

As compared to the anisotropic magnets of column macrostructure, currently made by the Baildon Metallurgical Works, the new materials are characterized by considerably improved magnetic parameters. A considerable reduction has also been obtained in cobalt consumption per one magnetic unit--by at least 20 percent, which result in substantial lowering of magnet weight. The production of magnets of this type could be started due to the development by the Institute of Materials Engineering of the Technical University in Warsaw of the metallurgical process and crystallization fundamentals of permanently magnetic materials of the ALNICO type with titanium, with column macro-structure, and with controlled equiaxial macrostructure. This process made possible to obtain the column macrostructure and controlled equiaxial grain macrostructure from permanently magnetic alloy of the ALNICO type at some 70 percent of ingot length. Alloys with such structures guarantee the obtaining of high magnetic properties.

The scientists in Warsaw also proved, that the conventional long aging of material at a temperature of 650-550°C permitting the obtaining of maximum magnetic properties, may be replaced by a considerably shorter multistage aging at the same temperatures, without lowering the magnetic properties. For an alloy containing some 8 percent Ti, a reduction of total aging time was obtained by some 80 percent, i.e., by almost 15 hours, and for an alloy containing about 4.5 Ti, this time was reduced by some 50 percent, i.e., 25 hours. This property results in a considerable reduction of time used for the production of permanent magnets of the ALNICO type.

As a result of the application of the new manufacturing method, magnets corresponding to the highest world standards have been produced at the Baildon Metallurgical Works with simultaneous considerable reduction of materials and power consumption.

Automatic Digital Radiolocator

The ARC-1404 digital radiolocator is a device intended for automatic taking of bearings on radio beacons, radio station, safety buoys and pulse signals (A1A, A2A, A3E, H2A, H3E) emitted by stations transmitting within the 250-550 kHz frequency band, and the 1,600-3,000 kHz band. This instrument allows of obtaining a digital indication of: course angle, course and frequency with an accuracy of 1°.

The ARC-1404 radiolocator operates in conjunction with any digital giro-compass repeater. It gives positive indications with the range of 0-360° without the need to define the side.

It is provided with an internal monitoring system and a unique system for quarter-turn error compensation of ±20°. It is suitable for universal supply and features negligible power consumption, amounting to 30 W. It may work jointly with a computer and a printer, and has a modular construction. The sensitivity of this radiolocator is 20 μV/m, indication scatter 2°, selectivity 1,000 Hz, 6 dB and 4,000 Hz—60 dB, ARW dynamics—± 80 dBV.

The maximum distance from the radiolocator is: for aerial - 100 m, and for the giro-compass digital repeater - 25 m.

To take a measurement it is sufficient to set up the frequency and select the kind of measurement wanted.

Bench Winder

The bench winder serves for winding contactor coils of relays, transformers, coils of rotor stators, and field coils of electrical rotating machines, and for other electrical equipment. It features a universal spindle speed range: 396, 798, 1,483, 3,000 r.p.m. and automatic guiding and laying of wires of a diameter range 0.04 to 2.5 mm.

The winder is equipped with a six decade electronic coil counter.

The maker of the winder is the KOMEL Factory of Special Electrical Machines and Process Equipment in Katowice.

Analog Induction Gauge CIMETR 1

The CIMETR-1 gauge is intended for differential and summary measurements, with the possibility of sorting into three dimensional groups. It is a two-limit differential instrument which may be mounted in stands and fixtures for linear and angular measurements in laboratory and industrial conditions.

The gauge is provided with the following units and components: measuring heads MDKa or MDKc, indicator MDNf-C, mains switch, switches for the measurement ranges and dimensional groups, and of the measuring head.

Basic technical specifications:

--measurement ranges: $\pm$ 5; $\pm$ 25; $\pm$ 100; $\pm$ 500 μm,

--magnitude of basic division: 0.2; 1; 4; 20 μm,

—zero compensation range min. 30 μm,

--mains supply 220 V, 50 Hz,

--control circuit voltage 250 V, 3A,

—outlet for a continuous recording device,

—pressure exerted by the measuring head—max. 0.3 N.

Programmable Pulse Generator, Type KZ 1509A

The programmable pulse generator of the KZ1509A type is a laboratory instrument controlled by a quartz generator. It produces electrical pulses of both polarity with discretely programmable pulse repeating interval, width and amplitude. In addition to continuous operation, the instrument is also capable of generating single pulse groups with programmable pulse repeating interval, width and number of the group. The pulse generator of the KZ1509A, controlled by a quartz generator, guarantees stability and precision of interval and width of the pulses produced, which allows its utilization as a master frequency source, time markets generator, frequency divider, time synthetizer, etc.

The use of an external quartz generator for control purposes makes possible to extend the range of periods and widths of the generated pulses at will to obtain values depending on the control generator frequency. In unconventional applications, the generator is particularly useful for the calibration of time base for oscilloscopes, testing frequency and time meter, and also when it is necessary to define accurate time intervals

The generator is provided with a digital readout of programmed characteristics, period range 0.2 μs - 999 with 0.01 percent accuracy, width range 0.1 μs - 998 with 0.1 percent accuracy.

The amplitude range under load of 50 ohm - 0.5-5 V, amplitude precision $\pm$4 percent. Positive and genative polarity. Possibility of generating single pulse group 1-999.

Reanimation Suitcase WRK-331

In the Electronic Medical Apparatus Works at Zabrze a portable reanimation apparatus is made designed for hospital wards and reanimation ambulances. The reanimation suitcase serves for cardiac reanimation in states of sudden circulation stoppage, for electrotherapy of certain heart rhythm irregularities and for monitoring and determining of ECG frequency.

Furthermore, the built-in dynamic memory makes possible a detailed supervision of the ECG even after the disconnecting of electrodes.

The apparatus makes also possible the stopping of the ECG image on the cardioscope screen for 10 seconds and readout of heart contractions directly from the screen. The construction of the WRK-331 suitcase enables also the controlling of proper electrode pressure at defibrillation, optical control of accumulator discharging and acoustic signalling of the presence of high tension.

When the operation is not carried out an automatic discharging of high tension takes place. The WRK-331 suitcase is of a compact design and low weight. Due to the small number of manipulation elements its servicing is very simple.

ZHR-89 Pipe Welder

At the Manufacturing and Repairing Enterprise of the Power Industry was developed and tested the ZHR-89 pipe welder. It is intended for butt-welding of pipes with diametres of 25 to 89 mm by the spark-resistance method. The welder makes possible to eliminate the labour-extensive gas and electric-arc welding.

Its application guarantees higher quality of the joint, and reduces many times the time required for its execution. Depending on the cross-section, the time required for making one welded joint is from 1 to 4 minutes.

All working motions of the welder are effected by hydraulically with the use of two pumps mounted in the hydraulic set.

The setting and control units are mounted in electric control cabinets. After the welding parameters have been set, the operation of the welder is limited to the use of two pedals and two electric pushbuttons system is cooled with main water.

The welder has a device for connecting a cylinder with protective gas, ensuring suitable reduction of gas pressure.

After the selection of the most suitable welding parameters for the given pipe material and cross-sections, the welder guarantees their reproducibility.

Two-Component Electromagnetic Log

The 4601 two-component electromagnetic log is intended for the measurement of two ship velocity components: longitudinal Vx and transverse Vy, and the distance covered by the ship. The log also gives data for the navigation equipment operating in conjunction with it. The 4601 log may also be used for measurement of flow speed of water through channels, corridors, etc.

The speed measuring range: of the longitudinal component Vx of forward or reverse speed--0-39.9 knots, of the transverse speed Vy to starboard or port--0 to 9.9 knots. The error in the definition of ship speed in relation to water does not exceed $\pm$ 0.3 knots.

The measurement range of the covered distance is from 0 to 9999.99 nautical miles, with an error not more than $\pm$ 2 percent at a cruising speed.

The resolution of the speed indicators is 0.1 knots and of the distance covered--0.01 nautical miles. The control signals generated by the main instruments of the 4611 log: 200 $\pm$ 4 pulses per 1 nautical mile and 100 $\pm$ 2 pulses per 1 nautical mile.

From the main instrument of the log are emitted analog signals of the longitudinal and transverse components of ship velocity.

The cancelling of the mileage meter is done by means of a pushbutton.

Sulphur Content Analyzer

Within the framework of scientific research carried out at the Institute of Nonferrous Metals of Gliwice, an analyser for the evaluation of sulphur content in pure metals and alloys has been developed. Its operation is based on the conductometric principle, and its range is from 5.10^{-4} to 5.10^{-1} percent of sulphur.

A specimen weighing precisely from 0.1 to 1 g is burnt in a resistance furnace in oxygen atmosphere, and the produced gas (mainly SO_2) is transported to the analyser, where in the measurement column a reaction occurs of SO_2 with acid solution of H_2O_2 to give sulphuric acid. The measured increase in conductivity, caused by the sulphuric acid produced, is the indication of sulphur content in the specimen.

The entire measurement cycle is automatic, and the servicing operations include only the preparation of the specimen, introducing it into the furnace, and starting the measurement cycle. The result is displayed digitally giving percentual content of sulphur with an error not exceeding 5 percent. Also the purging of the analyser and its preparation for the next measurement is carried out automatically.

Thus the time required for a single measurment is not more than 6 minutes.

New Peristaltic Pumps

The new peristaltic pumps--PP1-05, PP1-05A, PP2-15--due to their easily selected working parameters are versatile units intended for operation in scientific and research laboratories in the field of chemistry, biochemistry and medicine. They may also be used for routine tests requiring reliable equipment guaranteeing reproducibility of results.

The pumps are provided with a unified drive system with ninteen speeds. There is a possibility to use tubing with bores from 1 to 5 mm, which makes possible to batch fluids or gases in any required proportions, in quantities from 0.1 to 1,125 ml/min.

It is also very essential that the pumped medium comes into contact only with the pump tubing, ensuring conditions for a completely sterile work.

The pumps, made by the ZALIMP Electro-medical and Precision Apparatus Factory, feature an original suspension of the pumping race way, increasing several times the life of the pumping tubing, and making possible to use silicone rubber tubing of various thickness. This provides additionally for uniform pressing of all tubings to the pumping rollers, which guarantees uniform output from all channels.

The peristaltic pumps have small overall dimensions (230 x 170 x 150 mm and 310 x 170 x 160 mm) and weigh very little (5.5 and 7.5 kg).(ha)

Function Generator KZ-1405

The KZ-1405 function generator being an universal voltage source is particularly useful for checkup of analog or digital electronic circuits. It finds widespread application in scientific research and didactic laboratories. It is manufactured by the Scientific Apparatus Design and Manufacturing Work ZOPAN.

The KZ-1405 function generator is a source of sinusoidal, triangular and rectangular signals within a wide frequency range. Its technical characteristics are as follows:

--output signal: sinusoidal, triangular and rectangular,

--frequency range: 0.01 Hz-10MHz in 8 subranges,

--controlled symmetry: the ratio of the ascending to descending slope within the limits of 80:20 and 20:80,

--the possibility of generating a single pulse or a predetermined number of pulses with controlled phase within the limits of $\pm$ 90°,

--internal frequency tuning within the range of 1000:1;

--20 V output voltage at the open output (10 V under 50 percent load), attenuator--20 dB, 40 dB,

--reference voltage adjustment within the limits of ± 10 V,

--output impedance 50.

The generator permits the adjustment of output symmetry, output gating with simultaneous phase adjustment and reference voltage adjustment. By applying suitable external voltage the generated frequency may be varied in a very wide range—1000:1.

Welding Manipulator

The OM6-250 manipulator is intended to handle workpieces weighing up to 250 kg to be welded on circumference, by rotating it about an axis set in various positions at a steplessly adjusted rotational speed. This fixture may also be used as a positioner, i.e., a device used for setting up work to be welded by hand in a position convenient for the welder. In addition to these typical applications, the unit may be used as a supporting and driving set for the welding or building up cylindrical or tubular workpieces weighing up to 400 kg.

The manipulator is controlled with the use of a control desk which may be placed in any position convenient for the welder.

The body of the unit is a rigid box structure housing the electrical mechanisms. The table is made as a square plate with radial grooves for bolts fastening the workpiece or chuck.

The tilting of this table (max. 2.35 rad) is done with the use of a self-locking worm drive and an asynchronous motor. Special switches stop the motor in end positions of the table, which is rotated by a separate drive including reduction gear with a DC motor and a tachometric generator making possible to steplessly control table rotational speed in both directions, independently of its tilt.

The applied thyristor control system allows a continuous adjustment of table rotational speed, maintaining high stability even with an eccentric load on the table. The flow of welding current between the body to which the welding cable is connected and the table, is ensured by a very efficient and durable sliding contact.

The manipulator is also provided with a foot switch for starting table rotation when the use of the control desk is not convenient.

The rotational speed range of the table is 0.012-0.252 rad/sec. It is suitable for operation at 3 x 380 V supply, and the welding current cannot exceed 600 A.

New Longwall Support From FAZOS

The three-section longwall support type FAZOS-20/35-Oz Trojka is a new development of the KOMAG Mining Machinery Design and Engineering Centre. The first units constructed in the FAZOS Mechanized Longwall Support Factory are being checked under exploitation conditions in the Zabrze and Sosnica mines.

The new longwall support is designed in strongly inclined (up to 55°) and steep longwalls in 2.2 to 3.3 m thick seam mined with full caving.

The maximum height of the support is 3.5 m and minimum 2 m, yield load of support set ranges from 510 to 580 kN/m^2.

The complete set of a FAZOS-20/35-Oz-Trojka support consists of three sections connected by a common guiding beam. The main units of each section are: the cross-bar with built-in withdrawable roof-bar, lemniscate roof fall shield together with side sealing shields, guiding beam, two props of a yield load 1,410 kN each as well as shifting and correction actuators and control hydraulics elements or units. In the initial position the support sets are added to the conveyor.

Shifting of set takes place in three phases:

phase 1--shifting of guiding beam with the middle section,

phase 2--shifting of lower section,

and phase 3--shifting of upper section.

Tonsiometer--Fuel Economy

The Polish-Foreign firm DANPOL started--on the basis of a license developed by scientists from the Nautical College in Gdynia--the production of equipment called tonsiometers.

These are integrated instruments for measuring the torque, rotational speed and power on the ship's main drive torque, rotational speed and power on the ship's main drive shaft of seagoing vessels.

They consist of two parts: mechanical (mounted on the shaft) and electronic. On the digital panels of the latter parts the measured quantities are displayed every 10 or 100 seconds (values of torque, revolutions and power).

Thanks to the above instruments information is obtained concerning the percentage of maximum engine power utilized at the given moment. This information allows for the correct exploitation of ship engine plants and, therefore, for essential fuel savings.

Among the CEMA countries Poland is the only maker of this type of instruments which are made entirely from home components and parts.

Selective Nitriding

The selective nitriding method, developed at the Institute of Precision Mechanics of Warszawa, consists in two-stage thermal and chemical treatment of tools made of high-speed steels, and also of other medium and high-alloy tool steels.

The first stage of this process involves oxidation of tools in steam at temperatures ranging from 520 to 570°C. An oxide magnetite layer is formed on the metal

surface. Under high magnification of cross-section of the specimen, porous structure of the oxidized layer may be observed, the pores forming exclusively over carbides of the base. In places where there are no carbides only the alloyed ferrite, a layer is formed making diffusion practically impossible.

At the second stage of the process, the tools are subjected in the same plant to gaseous nitriding in an atmosphere of dissociated ammonia. The atoms of nitrogen penetrate via the pores to the underlying carbides and replace in them the atoms of carbon, increasing the hardness of carbides, thus also extending the useful life of tools.

The oxidized layer thus acts almost as a sieve, passing only a part of nitrogen atoms, hence the name of the process--selective nitriding. With the use of this process, an increase of hardness from 50 to 300 HV may be obtained, and the tools do not become brittle. It must also be emphasized that the entire process is carried out in a single plant. When introducing this method in the already operating heat and chemical treatment plants, only the furnaces must be adapted for it. Additional requirement only involve a retort and a batcher for nitriding, oxidizing, and nitriding-oxidizing atmospheres, so no investment is necessary.

The selective nitriding process is the most economic of all known until now, as regards consumption of energy and capital. It requires 60 percent less energy than the oxynitriding in fluidized beds, and 30 percent less than the fairly widely used in the world ion nitriding.

The new method is exceptionally pure. Even so small quantities of ammonia produced in the process are neutralized instantly with the use of a burner requiring a mere 0.01 cu.m. of gas per 24 hours.

This method has been tested in many Polish factories. The tools of SW3S2 steel made by selective nitriding are used for cutting steel wool, their life being from 5 to 12 hours. At the Telephone Equipment Factory of Warszawa selective nitriding has been applied to working parts of a support pressing tool, which up till now were made of sintered carbides. After making 12,000 of these supports, the tool shows no trace of wear. At the Polish Optical Works it was found that the milling cutters made of SW3S2 steel work 2.5 times longer than those made of SW18 steel.

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POLAND

NATIONAL MACHINE TOOLS CONFERENCE SLATED FOR 1985

Conference Agenda, Papers

Warsaw MECHANIK in Polish No 6, 1984 p 286

[Article by Prof Dr L. T. Wrotny, chairman of the organizing committee of the Fifth Conference on Machine Tools: "Fifth National Machine Tools Conference"]

[Text] In keeping with the tradition of conferences on development of machine tools and the machine industry in Poland (the last, fourth, conference took place in 1975), the Office of Machine Tools and Equipment of the SIMP, the Research and Design Center of Machine Tools at Pruszkow and the Institute of Mechanical Technology are holding in 1985, after almost a ten-year interruption, the Fifth National Machine Tools Conference in Warsaw under the title "Production and Development of Metal Working Machine Tools Is a Necessary Condition for the Existence of the Polish Engineering Industry."

The organizational committee defined the following basic goals of the conference:

- The machine tools fleet of Poland, consisting mainly of imported machines, is subject to natural technological and economic aging. It requires regular renewal, expansion and modernization, which is, given the current economic situation in the country, only possible through domestic manufacturing of plants and machinery.

The conference is expected to emphasize and demonstrate the need for recognizing the role of the machine tools and equipment industry as particularly vital for the existence of various branches of industry in Poland, especially for the engineering industry, which is the main consumer of machine tools.

- As long as we have a satisfactory industrial potential, it is possible to take appropriate steps and recommendations to protect the "industry of industry," as the machine tools and equipment production is described, from imminent degradation.

The conference must take an objective look at and assess the status of Polish machine tools industry, indicating the trends and possibilities of its

possible renaissance.

In industrialized nations, development of machine tools and equipment is going at a continuing fast pace. Polish industry is lagging behind the world level, and this gap in technology is increasing every year.

The conference is to present a picture of the existing Polish machine tools industry as regards the design and manufacturing of machines and components used in their construction and evaluate the current level of our technology as compared to the world level. This purpose will be served by surveys and reviews covering individual narrow technological problems.

- The economic reform being gradually introduced since 1982 has been influencing the organizational and technological structure of the enterprises in the machine tools industry.

The conference is expected to be a forum for an exchange of opinions among designers, developers and users of machine tools as far as the technical and organizational steps currently possible at production organizations, factory design bureaus and research and development institutes are concerned, and also with regard to integration of the units engaged in improved development of machine tools industry on a national scale.

- The economic situation in the country is not favorable for efforts by the engineering community. There is the danger of stagnation and even regression in the introduction of innovations. The goal of the conference in this area is to stimulate the professional activity of engineers and technologists in the machine tools area in an effort to help the nation emerge from the current crisis.

The subject scope of the conference pursues specific directions. The subjects proposed by the organizational committee, mostly concentrating on specific problems, were submitted to experts and specialists in machine tools for elaboration. Their reports, presented as articles, will be published in the MECHANIK magazine during late 1984 and the first months of 1985, and subsequently will be published as a monograph. These reports will include supplementary articles on machine tools published in MECHANIK in 1984 (including the paper on the modern machine tools industry in the light of the Fifth European Machine Tools Exhibition, 5 EMO, as well as statistical and other data). The ample collection of materials prepared for the conference will make it possible for its participants to familiarize themselves with and study the subjects before the actual sessions, which will take place in April of 1985 (the final dates will be announced in MECHANIK and also in mailed notices).

The program of the conference session, which will be one-day event, will only include main background theses and recommendations extracted from the reports, which will become the basis for a discussion of programs and problems to address the possibilities and methods of implementation of the goals of the conference. The speeches, discussions and recommendations adopted by the

conference will be published in one of the subsequent issues of MECHANIK.

The list of subjects proposed by the conference initiators is open. The organizational committee and the editors of MECHANIK encourage more articles, communications and speeches to be sent directly to the address of the editorial board. These materials will be covered in future issues of the MECHANIK as they are received.

In the current issue of MECHANIK, we publish the first series of materials for the conference.

State-of-the-Art Machining Centers Paper

Warsaw MECHANIK in Polish No 6, 1984 pp 294-300

[Article by Jan Gaciag, engineer with the machine tools factory "Mechanicy" at Pruszkow: "Toward the Fifth Machine Tools Conference 85: Modern Polish Machining Centers"]

[Text] A history of the development of numeric control and machining centers. A description of attempts by Polish machine tools industry at designing original domestic prototypes of machining centers. Design concepts of the prototypes. The industrial production of machining centers on the basis of licensing agreements and cooperation and descriptions of designs and technical specifications of these centers. Recommendations on the development and production of machining centers in Poland.

Development

A machining center is a numerically controlled machine tool with automatic change of tools that is used for machining of objects involving the execution of the following functions: milling, drilling, turning, boring and threading.

The first machining center was created by Kearney and Trecker in 1958. Four years before that, the first public demonstration of a numerically controlled machine tool was made. It was the milling machine Hydrotel manufactured by the firm Cincinnati which used the control system and servodrives built by the Massachusetts Institute of Technology (USA).

The concept of numeric control originated in 1947 at Parsons Corporation. Towards the end of World War II, this firm began to switch over from production of bombs to production of aircraft components. Progress in the construction of new fast military aircraft presented increasing difficulties in the machining of mechanical parts. These parts began to have increasingly more complex shapes, which could only be produced by exact coordination of movements along two and frequently even three axes, such that the advance of the machine ensured the required path of the tool.

The proof of the possibility of creating such a machine was given by John Parsons and Frank Stulen of the Parsons Corporation. They calculated on conventional bookkeepers' calculators the consecutive coordinates x and y for 200 points along a flat template of an aircraft profile. The machining experiment was made on Bridgeport horizontal milling machine. Manual control of movement along axes X and Y was done by two operators, which were given coordinates of successive points to be set on the control dials during the course of machining. The results were astonishing, because the machining precision reached ±0.2 mm. It took another seven years before the concept was implemented. It was made possible by the advent of the computer, which allowed calculating the coordinates of a large number of points and their synchronized recording on magnetic tape, which was then fed into a machine tool control.

Since 1954, the numeric control of machine tools began to be developed. Initially, applications were limited to milling machines, especially for work on components of a complicated shape. Six years after the creation of the first NC machine, 10 percent of machine tools demonstrated at the Chicago exhibition in 1960, out of a total of 1,000, had numeric control.

The first work on numeric control in Poland was started in 1957. By decision of the Ministry of Engineering, a group of organizations was set up for this purpose, which included representatives from the Central Office of Machine Tool Design [CBKO], the Institute of Electrical Engineering [IEL] and the Institute of Mathematical Machines.

The experimental system of numeric control with magnetic tape was created in 1961 at CBKO. It was tested on horizontal milling machine FYA 41, manufactured by the May 1 Industrial Enterprise in Pruszkow.

The movement along axes X and Y was provided by hydraulic drives with servocontrol. In that year also, the Center of Numeric Control at Elwro Enterprises in Wroclaw developed prototypes of a numeric control system based on punched tape, with the brand name Mrowka. Trials of the system were made on an indexing cross-table designed and manufactured by May 1 Enterprises. DC drives were used for movement along the axes X and Y, with electronic control by a system that used thyratron valves. After 1961, work on these machines proceeded only at CBKO and IEL. In 1961, a model system of numeric control with line interpolation and block reader of punched tape was developed at CBKO. The system was used in two-spindle milling machine FEA 63N (Fig. 1).

As a result of work at IEL, a numeric control system SPF-100 was created with a line-circular interpolator enabling simultaneous operation on three axes with line interpolation. Circular interpolation was possible on the planes xy, yz or zx. The milling machine FYA 41, on which the SPF-100 system was used, had a direct measurement system developed by IEL.

After 1965, the development of numeric control machines was conducted exclusively at CBKO. There the industrial prototype of numeric control system

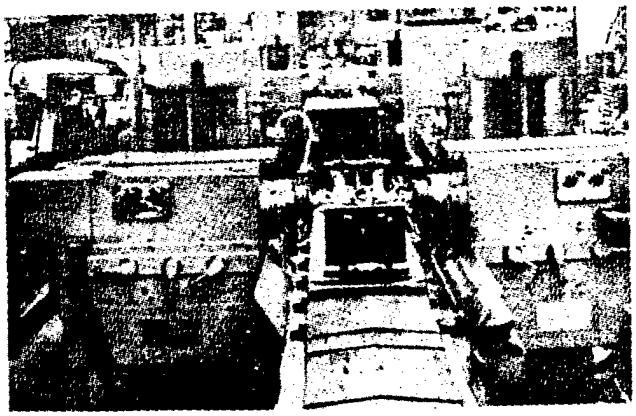

Fig. 1. First Polish numerically controlled machine tool FEA63N

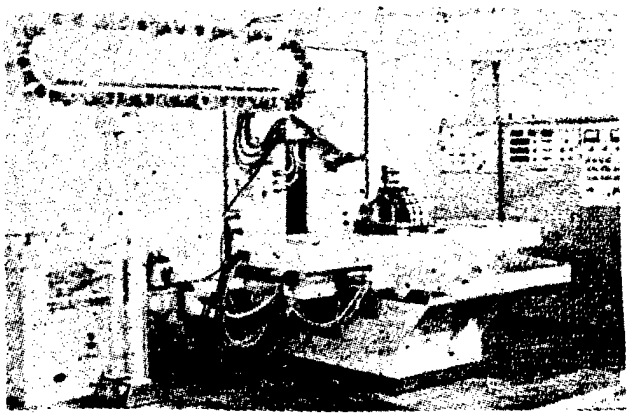

Fig. 2. Experimental prototype of horizontal machining center FXF 50NM

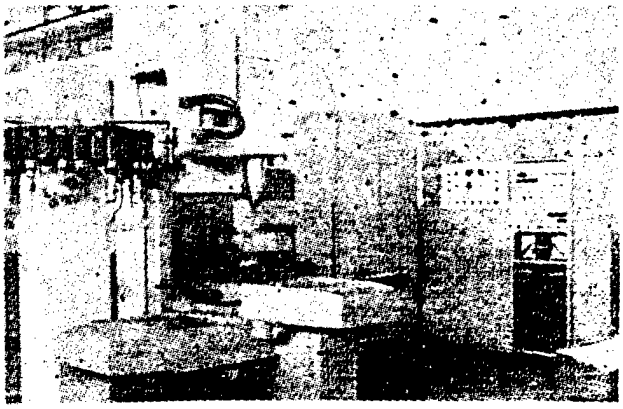

Fig. 3. Prototype of vertical machining center WKE 40NM

NUMEROBLOK was developed. In 1969, May 1 Enterprises at Pruszkow began to manufacture machine tools with this control system. These were specialized bed milling machines FEA 63N, intended for machining of steam turbine blades. Electrohydraulic servodrives were used to control the movement with a hydraulic motor.

At the end of the 1960's, work was begun at CBKO to develop a standard family of numeric control systems, FOTOSTER. These systems were used mainly on drilling machines WAB 25N and WAC 25N. With more complicated machines, the failure rate of control systems was so high that successful operation was practically excluded.

In 1971-1975, a prototype of numeric control on integral circuits NUMS 331FC was developed and implemented at CBKO. The system was ready at about the same time as the license-based computerized numeric control system CNC NUCON 400.

The first attempts at constructing machining centers were made by CBKO. In 1968, the principles for the construction of compound-table milling machines FF 40/50 were developed. One of these machines was the multifunctional machining center FXF 50NM with a magazine of the capacity of 24 tools, 18-degree spindle drive, a conventional gear box and electrohydraulic servodrive, which consists of a one-step servovalve and a hydraulic motor. The horizontal machining center FXF 50NM was to be furnished with numeric control system FOTOSTER II. This experimental prototype was ready in 1971 (Fig. 2). The results of tests were unsatisfactory. Numeric control and the transmission adjustment-control system had a high failure rate. The servodrive failed to provide the required regulation range and its dynamic properties were inadequate. The experiment indicated that reliable NC machines can only be built with reliable numeric control systems and servodrives. It was therefore impossible to undertake the production of machining centers in Poland without import of assemblies.

At about the same time, CBKO was working on vertical machining centers, which had several varieties: drilling machines, drilling-turning machines and drilling-milling machines. These classifications affected the design concept of the vertical machining center and introduced unnecessary complications into design solutions, including duplication. There were no such difficulties in designing the horizontal center, which has to drill, turn and mill under more difficult conditions (hanging tools).

The prototype of vertical drilling center WKE 40NM was finished in 1973 (Fig. 3). The design concept of this machine was better than the earlier FXF 50NM type mentioned earlier. The DC drives controlled by thyristor systems (drives manufactured by Siemens with APATOR thyristor systems) were installed on this machine. This center used the FOTOSTER numeric control system with a transmission system of adjustment and control (UDS). Numeric control and UDS did not operate reliably, denying the desirability of starting the large-scale production of this machine. Under pressure, a prototype series was made, but the results of tests were negative.

The next machining center of CBKO was a planer-type milling machine FXK 63NM, patterned in certain respects after the Modul-Line centers manufactured by Kearney-Trecker. After building the prototype and testing it, the project was abandoned.

In a situation where all new designs of machining centers were abandoned due to unreliability and low quality of electronic components, the decision was made to build the KOR system for processing of machine bodies with computer control. This system was assembled in 1975. It was a prototype in its entirety and in all components. The system was based on the FXF 50NMS and WKE 40NMS. The former was a new version of experimental prototype FXF 50NM with DC drives. The vertical center WKE 40NMS, however, was standardized with components of horizontal center, from which the bed, the sleds and the table were adopted. After the centers were furnished with numeric control and DC servodrives, they became the best operating elements of the KOR system.

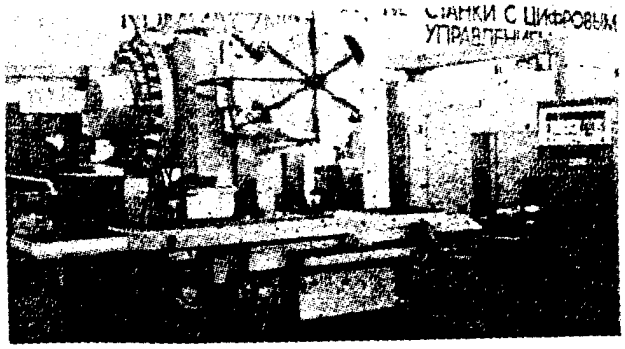

Fig. 4. Vertical machining center FYJ 40RNM

In 1974, at FO Mechanicy in Pruszkow (May 1 Enterprises), the vertical machining center FYJ 40RMN was created. It was based on a knee-type milling machine with a turret head, controlled by FOTOSTER numeric control system (Fig. 4). In 1975, the prototype numeric control system NUMS 331FC was tested on this machine. The results of the trial operation provided a basis for production of numeric control systems NC NUMS 331FC. These systems are currently produced and enjoy popularity both among machine tool producers and users.

In 1977, two machining centers were developed at MTP: vertical machine FYM 63NM (FO Mechanicy) and horizontal machine WFG 100NM (factory at Dabrowa Gornicza). These two machines had a common concept: tool magazines manufactured by Fritz Heckert (GDR). Difficulties with cooperation, however, caused FO Mechanicy to equip the FYM 63NM machines with a magazine of their own design. This machine was a modernized version of the WKE 40NM, adapted to U.S. requirements. The main changes concerned the guides and bodies, especially the variable machining space required in those markets.

In 1977, a cooperation agreement was signed with the Mitsui-Seiki company. On the basis of this agreement, FO Mechanicy Enterprises began the production of vertical machining centers HP4 and HP5. In 1975, mass-scale production of machining centers was started in Poland. This occurred exactly 20 years after the first presentation by Kearney and Trecker of the first machining center in the world. The HP4 and HP5 centers were furnished with parts and assemblies manufactured in Poland under a license. These included: numeric control, feed drives, spindle drives, hydraulic elements and cast iron bodies.

The quotient of imported components in these machines, however, was high. The list of imported components included LSI, VLSI, drives, clamping devices, shields of guides and bolts, wipers, line inductosyns, precision head gears for indexing tables, precision beds, serial microconnectors, etc. This was a result of poor organization of research and development in the industry, because the designs of numeric control systems was performed entirely by individual enterprises. In addition, other failures and counterproductive trends of that period should be mentioned:

--lack of development work in the area of servodrives of feeds and measurement instruments, as well as other components necessary for proper operation of NC machines;

--lack of concistency in prototypes and disregard for negative findings;

--research and development based on domestic experience only and a lack of specimens or poor access to slow progress in obtaining positive results;

--development of numerically controlled machines without looking at the perspectives of their possible implementation (production of so-called shelved concepts).

The unsatisfactory prototypes failed to encourage demand on the part of enterprises for introducing them into production processes and channeling the limited efforts of research facilities into the new problem areas.

Industrial Production of Machining Centers

Initial Projects

As has been mentioned, the industrial output of machining centers was started at the Mechanicy Machine Tools Enterprises in Pruszkow. The choice of the factory was not accidental but the result of the near location of the Machine Tools Research and Development Center and the activity of the design and development center at FO Mechanicy, which not only implemented the CBKO designs but conducted its own research. Important were negative results of attempts at introducing vertical machines WKE 40NM and positive findings with the vertical machine FYJ 40RNM developed by the factory's own staff. The designers at FO Mechanicy mastered in developing this machine the UDS design principles with integrated circuits and contributed to the production of numeric control systems NUMS 331FC with integrated UDS.

The UDS system in FYJ 40RNM center, which, in addition to the tool magazine, had a turret head, was more sophisticated than the systems developed until that time at CBKO. The change of tools occurred from two spindles rather than one, as in the earlier machines. On the remaining four spindles, the tools could be changed only manually. Both spindles had a setting mechanism in one position for automatic change of tool. During the change, the spindle nests were automatically ventilated by an air flow. The new elements introduced and tested in practice included: the control of oil level in the hydraulic collectors and lubrication systems and automatic periodic lubrication of guides. Initiators were used to control the functions whose proper performance was preconditioned to subsequent series of operations.

The start-up of the industrial production of machining centers was preceded by further research based on application of numeric control systems manufactured by General Electric, the MBD 550 and ASEA NUCON 400 on knee-type milling machine FYJ 40RN with a turret head. The designers at FO Mechanicy successfully tested the possibility of joint operation of this milling machine with six different numeric control systems: FOTOSTER, UMAC-732, NUMS-FC331 (prototype), MBD 550, NUCON 400 and NUMS-FC331 (mass produced).

Fig. 5. Vertical machining center FYM 63NM

Vertical Machining Center FYM 63NM

The vertical machining center FYM 63NM was several times modernized before it was introduced into industrial production. The original prototype had a spindle with an electromagnetic cog gear box, numeric control NUMS-331FC and the tool magazine made by Fritz Heckert. The final version that went into serial production was a center with spindle without gears and two-step hydraulically controlled cog wheel transmission with the tool magazine of the factory's own design and numeric control CNC-NUCON 400 (Fig. 5).

This center has a table with a working surface of 635 x 1270 mm, or 635 x 1570 mm. The admissible weight of the workpiece is 2000 kg. The advance range of the feeds along axes X, Y and Z are 1070 mm, 560 mm and 690 mm, respectively. The operating feeds along all axes can be regulated continuously in the range of 1-3,000 mm/min and in fast advance also 8 m/min (axes X and Y) and 6 m/min (axis Z).

The spindle has a conic nest ISO no. 50. Its rotation speeds range between 10 and 30-40 rev/min, and the power of the main drive is 11.2 kW. The drum magazine accommodates in an arbitrary sequence 24 tools with a maximum diameter of 150 mm and weight of up to 11 kg. The time of tool change is 12 s, and the time "from chip to chip" is 20 s. The machine weighs 10.5 t.

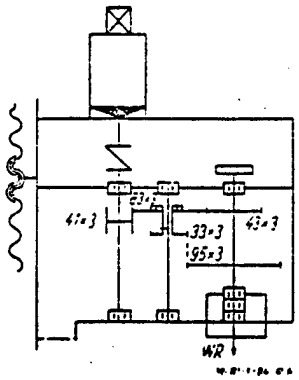

Fig. 6. Spindle drive of machining center FYM 63NM

A diagram of the spindle drive of the FYM 63NM is shown in Fig. 6. The spindle in the front support is positioned in double ball bearings (with initial drive). In the rear support a conical double-roller bearing is used. The front bearings are lubricated wtih permanent lubricant "for life." The rear bearings are lubricated with dispensed oil drops.

For lowering the temperature of roller bearings, autonomous ventilation is used activated during the operation of the spindle. This results in a lowering of the temperature by 20°C.

Gear transmissions are lubricated by an oil flow directed between the cog wheels. Despite the high speed of the wheels, the spindle of this design has a low peripheral velocity. The wheels are polished on a Maag grinding machine.

The guides of the spindle, the bed and sleds are made as steel parts bolted to bodies. They are made of steel sheets hardened and ground on a Waldrich-Coburg grinding machine. Contact surfaces are coated in Turcite to insure low resistivity and smooth advance at low speeds. Transmissions are lubricated automatically, which occurs periodically, initiated by a signal of low oil levels in the lubrication system collector.

Direct current drives power the advance feeds with permanent magnets, precision screws and cog and belt transmissions. The precision screws are supported by needle roller bearings INA.

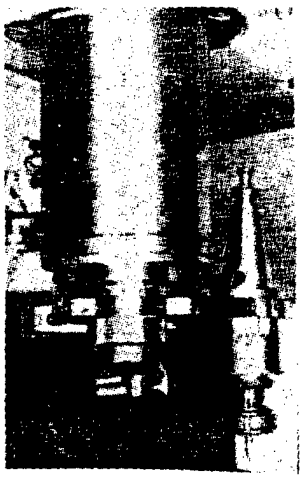

Fig. 7. Tool feeder of FYM 63NM

The drum tool magazine is installed on the side wall of the machine. The tool changing mechanism performs a complicated cycle of movements in view of a large distance between the magazine and the spindle. To reduce the tool changing time, the mechanism has two tool clutches which rotate at an angle of 60° (Fig. 7). One clutch takes the tool to be installed and the other removes the tool from the spindle.

During tool changing, the spindle is always put in the same angular position by a hydraulically controlled mechanism. As the conical tool clutch is placed into the spindle socket, automatic ventilation is turned on to remove impurities. The tool is always fixed automatically with the aid of disk springs.

All mechanisms performing the operations for machining are controlled by initiators and covered by error diagnostics executed by control system CNC-NUCON 400.

The machining center FYM 63NM has a hydraulic system which serves to change gears in the spindle transmission, powers the drives of the tool magazine and feed, relieves the pressure on the horizontal screw drive of the spindle and the tool.

The principal assemblies of the control system are made in Poland. These include the thyristor system of spindle and feed drives (ZAE-APENA), feed drives (WAMEL), spindle drives (WIEFAMEL), hydraulic elements and power drives (ZEO-Wadowice), numeric control system CNC-NUCON 400 (MERA) and line inductosyns (CBKO).

Horizontal Machining Centers HP4 and HP5

The horizontal machining centers HP4 and HP5 are constructed by FO Mechanicy on the basis of design documentation obtained from Japanese firm Mitsui Seiki under an agreement for industrial cooperation signed by Metalexport and FO Mechanicy. The contract was signed on March 1, 1977. Mitsui Seiki has supplied to FO Mechanicy the new design (HP4 prototype in 1974 and the first series in 1975) recently introduced into production.

Why was it decided to use a license despite the fact that at the same time a domestic design of a vertical center was being introduced? The development of a domestic horizontal machine ran into a conflict with the production KOR system. The decision to build this machine led to cancellation of further development of the FXF 50NM prototype, because all efforts and funds had to be allocated to KOR development. As a result, Poland was the only country among nations with an important machine tools industry which in the mid-1970's was unable to produce its own machining center, especially a horizontal one. The cooperation agreement with Mitsui Seiki helped to rapidly overcome this backwardness. The design documentation of HP centers offers a large number of variations (see table), which met the needs of domestic and world markets. The basic design of HP4 and HP5 is the same. Both centers have standard components: spindle, magazine and tool-changing mechanism for 24 or 32 tools, hydraulic drive and hydraulic control system, numeric control system and UDS, thyristor system of spindle drive, thyristor system of feed drives, electric system, as well as tool-cooling system.

Table

Machine type		
HP4	HP5	Implementation
HP4-19	HP5-19	AWN24 + 4 x 90°
HP4-06	HP5-06	AWN24 + 0.001°
HP4-38	HP5-38	AWN32 + 4 x 90°
HP4-28	HP5-28	AWN32 + 0.001°
HP4-18	HP5-18	AWN24 + 4 x 90° + AWP
HP4-41	HP5-41	AWN24 + 0.001° + AWP
HP4-31	HP5-31	AWN32 + 4 x 90° + AWP
HP4-10	HP5-10	AWN32 + 0.001° + AWP

AWN24 = 24-tool magazine; AWN32 = 32-tool magazine; 4 x 90° = four-position indexing table; 0.001° = rotary table with continuous indexing; AWP = automatic palette change.

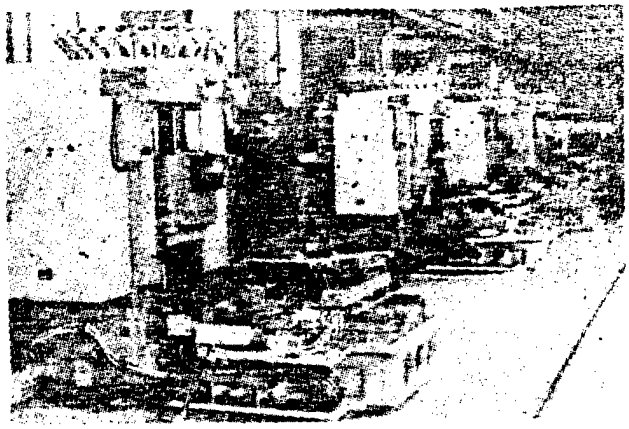

Fig. 8. Assembly of horizontal machining centers HP4

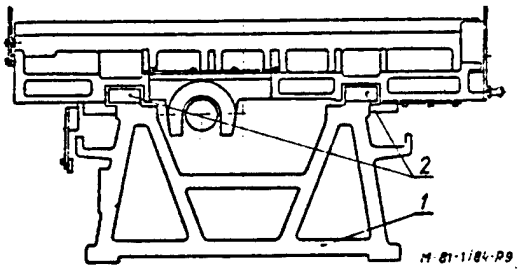

Fig. 9. Cross-section of the bed of an HP4 machining center:
1 - body, 2 - guideways

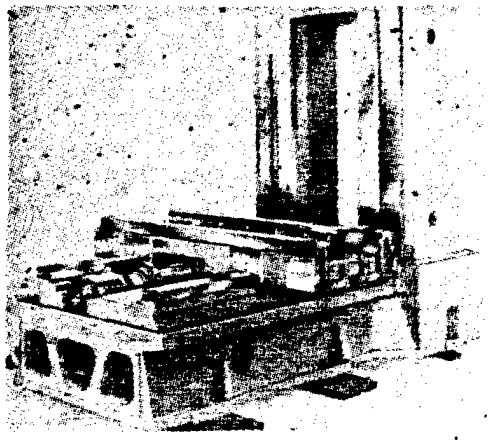

Fig. 10. System of bodies of HP4

The machining centers belong to the class of precision machines. To ensure a high quality of assembly, FO Mechanicy had to modernize the assembly workshop and build special basements to ensure stability of machines during the entire assembly cycle (Fig. 8).

The design concepts of HP centers are based on experience accumulated by Mitsui Seiki during the construction of various commonly known coordinate drilling machines. This is seen in particular in the form of bed bodies in Figs. 9 and 10.

An interesting design concept is the system of spindles of HP (Fig. 11). The spindle is placed in the front support on a double-row roller bearing and double-row tapered bearings, and in the back support on conical ball bearings.

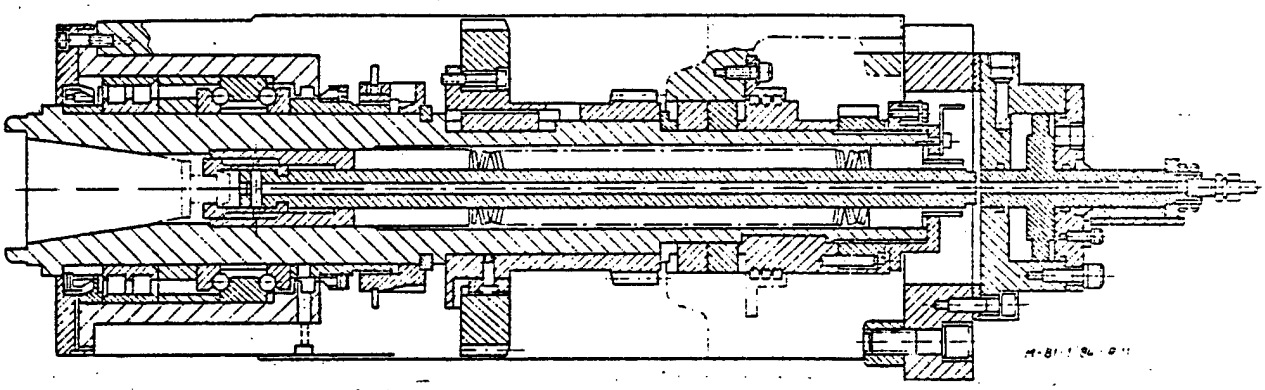

Fig. 11. Spindles of HP mounted on bearings

The front bearings, especially the double-row roller bearings, produce a large amount of heat when operating at high speeds, which leads to temperature rise of the entire assembly, with unfavorable thermal complications. In order to reduce the operating temperature of bearings, an aluminum coupling with nickel-phosphorus coating was used. The thermal expansion of aluminum is double that of steel. During the operation, this produces an autonomic thermal regulation due to the difference of thermal expansion between aluminum and steel. The state of internal stresses of the bearings is changed, leading to operational temperature stabilization at a level ensuring precision work of the spindle.

The kinematic system of the spindle drive is simple (Fig. 12). The drive has a high dependability, making it possible to use almost the full power of the motor when machining.

The mechanism of angular position of the spindle is simple, which is used when changing the tool or for turning without a template. The mechanism is illustrated by Fig. 13. In the position shown in the figure, the spindle is maintained by limited moment of the direct current motor.

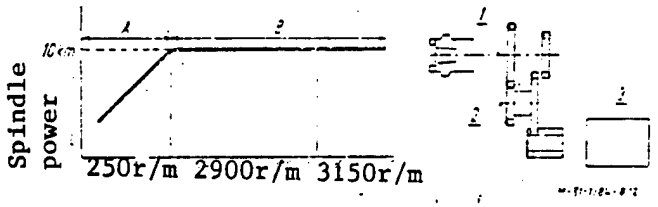

Fig. 12. Spindle drive of HP4: A - control by armature current, B - control by magnetic field; 1 - spindle, 2 - feed ring, 3 - drive motor

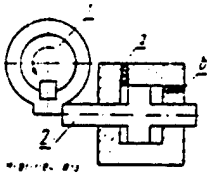

Fig. 13. Mechanism of angular positioning of the spindle of HP4: 1 - spingle, 2 - stopper lock (a - on, b - off)

A high precision of position of feed elements $T_{ue} = 0.02$ mm is obtained by rigid mechanisms of feed drives. The drives are connected directly to the feed screws. The bearings are placed in rigid casings. The bearings and feed screws are mounted with an initial tension. To decrease the effect of friction resistance, which is greater in the advance guideway (regulation wedges), the feed screws are positioned asymmetrically relative to the guideways (Fig. 9). The guideways are made of hardened steel sheets and contact surfaces are covered with Turcite sheets. The guideways are lubricated automatically on periodic activation. Line inductosyns serve to measure the position on directions of axes X, Y and Z (Fig. 14).

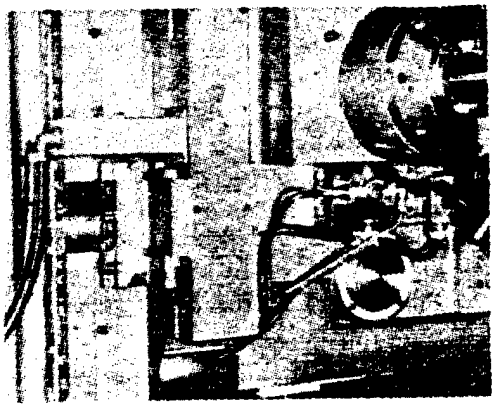

Fig. 14. Inductosyn of axis Y of machining center HP4

Machining centers HP can be furnished with an indexing four-position table or rotary table with continuous division. In the former case, the precise position of the table is ensured by a precision Curvic coupling and in the latter by a circular inductosyn. Both tables are available in an option with automatic skid replacement.

The system of table guideways is typical for a milling machine. The table advances horizontally perpendicular to the spindle axis (feed x), while the guide of the table is parallel to the spindle axis (feed z). The spindle has horizontal movement (axis Y). The bed on which the spindle moves is stable and shaped as a rigid frame. The tool magazine is located at the top of the frame. Depending on the needs, the magazine can contain 24 or 32 tools. In the former case, it is a disk magazine, and in the latter a chain-type magazine.

The palette changer is situated at the front of the machine. The changer has two positions for fixing and releasing the workpiece and replacing a finished workpiece with the one to be machined next.

The machining centers are controlled by numeric computer control systems CNC-NUCON 400. UDS is an integral component of numeric control. The programmed adjustment-control system (UDS) has many advantages. The main merit of this concept is high operational reliability. The control system CNC-NUCON 400 has a diagnostic component which controls the flow of the operation, UDS and the mechanisms of the machine.

Dozens of HP horizontal machines are currently produced every year. This number satisfies the domestic market and allows export of a large number of units. The HP4 centers have been sold to Western nations with Siemens numeric control systems. There are plans to enlarge the family of HP machines and offer an option with 72-position tables and a palette magazine.

The HP4 machine has a square four-position table, 500 x 500 mm in size and a maximum load of 800 kg. The HP5 has a round table with diameter of 700 mm and a maximum workpiece load of up to 1000 kg. The range of feed movement on axes X, Y and Z is 6100 mm, 550 mm and 500 mm, respectively, for the former model, and 850 mm, 700 mm and 650 mm for the latter model. The distance between the spindle axis and the table surface can be changed in the HP4 in the range of 150-650 mm and in the HP5 between 150 and 850 mm. The distance between the spindle top and the table rotation axis is 200-750 mm and 250-900 mm, respectively. Both types have the same power of main drive (7.5 kW), the same range of spindle rotation speeds (10-2900 rev/min) and feed drives (1-300 mm/min) and the same speed of fast feed (10 m/min). The programming step in both machines is the same and equal to 0.002 mm. The tools in the magazine have the grip MAS 403-BT50. The diameter is not larger than 150 mm or 280 mm (when adjacent nests are not occupied), the length is 320 mm and the weight 15 kg. The time of tool change is 5 s both in the HP4 and HP5, but the time "from chip to chip" is 15 s. These data refer to standard varieties. Specialized options can be furnished with a rotary table with a continuous division (n = 4 rev/min, minimum program revolution 0.001°) and

32-input tool magazines (ϕ_{max} = 125 mm or 250 mm). There is also a possibility for producing these machines with a higher range of spindle speeds (50-3150 rev/min).

Developments at Tarnow Enterprises

Horizontal Machining Center TC1-1250P

This machining center was developed under cooperative agreements between Ponar Machine Industry Association and a group of companies DIAG in the FRG. This group of companies included, among others, Wotan, Werner and Kolb. One of the joint projects was cooperative development of machining centers based on the experience of the Werner firm. Werner proposed the design of a center standardized with TC1-800 with variations in the design of the table. This machine with index TC1-1250P was developed by CBKO jointly with Werner. In this way, Poland has obtained the license for production of the center and its sale through the firm DIAG on Western markets and cooperation on supply of some of the assemblies to Werner.

The prototype center was made in 1980 at the Tarnow Engineering Enterprises (Ponar-Tarnow). This machine (Fig. 15) is intended for work on heavy bodies and accommodates larger workpieces than the HP4 and HP5. Accordingly, it is based on different design concepts. The spindle drive has a four-stage transmission, enabling the spindle to develop a more powerful moment and a longer period of operation at a permanent power level. The powerful drive makes it possible to use deeper cutting teeth.

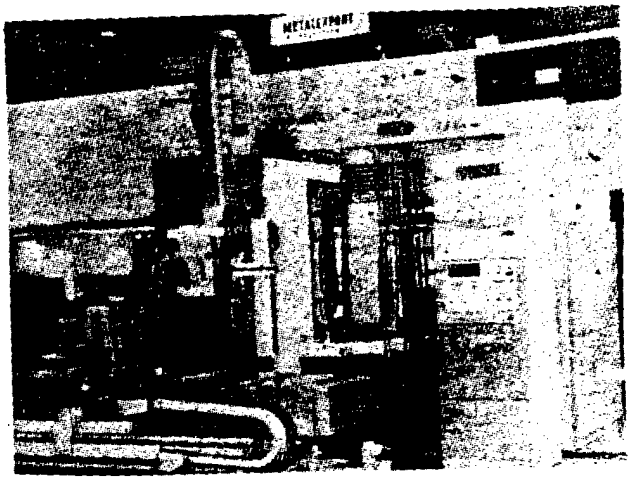

Fig. 15. Vertical machining center TC1-1250P

The bed is mobile (feed z). The spindle can be moved along axis Y, determined by the vertical guide of the table. The table only moves in one direction along

the axis X. All guideways have steel panels with advance blocks, in view of the heavy loads. With this design, combined with linear position drive, a high positioning precision is obtained for axes X and Y, for which $T_{eu} = 0.015$ mm and in axis Z $T_{eu} = 0.02$ mm.

The spindle is placed in precision conical ball bearings and equipped with angular position mechanisms (so-called oriented stop), with the same principle of operation as in HP centers. The ventilation of the spindle and tool fixation mechanisms are also similar.

The TC1-1250P center is produced with a rotary table with an accuracy of rotation of 1° (axis B). The 40-tool drum mechanism is placed at the side of the movable bed. The tool-changing mechanism is integrated with the spindles. The magazine and tool-changing mechanisms are made according to the design of TC1 centers originally made by Burr and adopted by Werner. The magazine is powered by hydraulic drive and a cam operating together with the drum rollers. The shape of the cam is such that for stopping the magazine drum in the position of tool change a lock should be in a specific position. During the operation of the spindle, one shoulder of the changing mechanism remains in the channel of the tool grip. The tool holders are encoded individually with the aid of nine stoppers placed on the cone of the tool grip. This concept is obsolete and requires the use of special tool grips.

Lubrication is centralized, with control in the rotary conduit, where the pressure gauge is placed. In case of damage to the lubrication circuit and a leak of oil, a pressure drop triggers an emergency signal which stops the machine. Different from HP centers, the entire hydraulic system is located in the free-standing hydraulic feeder, connected with the executive elements by power lines. The TC1-1250P center has a computerized numeric control system CNC-NUCON 400.

The table is 800 x 1250 mm in size and accommodates workpieces weighing up to 1200 kg (2000 kg). The feeds along the X, Y and Z axes have ranges of 450 mm, 800 mm and 800 mm, respectively. The working movements are programmed in the range of 1-2000 mm/min, and the fast advance speed is 12 m/min. The spindle with a diameter in the front bearing of 100 mm has a head stock no. 50 and is powered by a drive of 22 kW. Its rotation speeds range from 20 to 3550 rev/min. The magazine accommodates tools (40 units) with diameters of up to 120 mm or 200 mm (when adjacent nests are unoccupied) up to 400 mm long, with a maximum weight of up to 20 kg. The tool changing time is 5 s, and the time "from chip to chip" is 12 s.

It should be mentioned that as of now only three copies of this machine have been produced by Tarnow Machine Tool Enterprises.

Conclusions

The development of the production of machining centers still does not occupy its proper place at our machine tool enterprises. The following causes are responsible for this situation:

- The enterprises for machine tool production are not adequately equipped. They experience a shortage of specialized machines for production of precision couplings such as Hirth or Curvic couplings (Gleason), cutters for machining precision, worm gears precision grinders such as Maag for tooth wheels and control and measurement equipment.

- The poor organization of production at factories makes it difficult to analyze and utilize the available documentation and knowhow, and the long cycle of the production of prototypes and their introduction into industry results in obsolescence of the final product.

- Insufficient numbers of design bureaus at factories makes it impossible to develop and utilize documentation and local experience for creation of new types of machining centers.

- An obstacle to further progress is obsolete systems of numeric control due to shortages of adequate component base and limited numbers of personnel capable of designing and programming CNC systems.

- Domestic industry does not have a specialized basis in the production of centralized lubrication systems, synthetic materials for guideways, front blocks, precision bearings, electrical engineering components, electric and hydraulic drives, which are necessary for the construction of new machining centers.

- In the research and development work of the central facilities, after failures with experimental production systems KOR, a complete stagnation has set in. Despite the development of machining centers HP4 and HP5, new work for development of hardware and software is not undertaken, although these are indispensable elements for concepts such as the Flexible Machining System. The absence of skilled personnel for developing control programs of such systems is a major drawback.

BIBLIOGRAPHY

1. Gettelman, K. M. and Albert, M. D., "Fundamentals of NC/CAM," Modern Machine Shop, 1983.

2. "VI Portrait of AM: The Way It Happened," AMERICAN MACHINIST, 22 Apr 1968.

3. Mierzejewski, J., Jakubowski, J., Lewandowski, T. and Kaczynski, J., "Rozwoj systemow sterowania numerycznego obrabiarek w Polsce. Referat" [The Development of Systems of Numeric Control for Machine Tools in Poland: A Report], CBKO, 1973.

4. "Zalozenia FF40/50, WKE 40NMS, FXF 50NMS" [Specifications for the FF40/50, WKE 40NMS and FXF 50NMS], CBKO.

5. Szymanowksi, W., "Koreferat do zalozen konstrukcji centrum obrobkowego FXF 50NMS do systemu KOR" [Principles of Design of Machining Center FXF 50 NMS for the KOR System].

6. Szafarczyk, M., "Koferat do zalozen centrum obrobkowego wiertarskiego typu WKE 40NMS przystosowanego do pracy w systemie KOR" [Principles of Design of the Drilling Machine Center WKE 40NMS Type Adapted for Operation in the KOR System].

7. ZM Tarnow and FO Mechanicy Prospectus.

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POLAND

METHODOLOGY FOR STRESS ANALYSIS OF HEAVY METAL PLATE

Warsaw BUDOWNICTWO OKRETOWE in English No 10, 1984 pp 4-5=407

[Article by Dr Hab. Eng. Marian Kmiecik, Mgr Eng.Alfred Jazukiewicz of the Ship Research Institute Technical University of Szczecin : "Effect of Boundary Conditions, Initial Stresses and Initial Deflections on the Load-Carrying Capacity of Plates Under Uniaxial Compressions"]

[Text]

Presentation of the calculation results of the load-carrying capacity of plates having initial deflections and stresses, the calculations having been carried out with the PLAMES computer programme. Investigation were carried out with square and rectangular plates with simply supported and rigidly fixed edges, also with those with restrained and unrestrained edges of their middle planes.

Plates constitute basic elements of all stiffened flat shell and of all thin-walled beams and columns. The load carrying capacity of plates has, therefore, crucial effect on the performance of the structures. The load-carrying capacity of plates in turn depends on their slenderness, their boundary conditions and on the initial deflections and stresses generated in plates by fabrication processes used during the construction of the structures.

The work contains calculation result of load-carrying capacity of plates under uniaxial compression as the compression is the most dangerous loading for distorted structures. Simply supported ($k = 0$; SS) and clamped ($k = \infty$; CC) plates were investigated with and without initial deflection (w_o) and initial stresses (σ_r, Fig. 1).

When relatively light stiffeners are welded to a plate, then the coefficient of its restrains k is nearly zero and the plate may be treated as simply supported. When, on the other hand, very heavy stiffeners are used then it should be assumed that the edges are clamped ($k = \infty$). The two extreme cases were, therefore, analysed to depict properly the influence of the rotary edge restrains on the behaviour of plates.

Plates constituting segments of stiffened flat shells are not free to deflect in transverse direction with respect to their axial loading ($v = 0$, Fig. 1). This freedom, however, exist when plates are parts of thin-walled axially loaded columns made of simple angle, channel, tee and the like sections or made as thin-walled box girders of square or rectangular cross-sections. The differences in the behaviour of plates caused by the possibility of movement of their middle planes were, therefore, also investigated.

The investigations were carried out by means of PLAMES computer programme whose detailed description is given in [1]. The programme is based on finite element method and enables strength analysis of any stiffened flat panel under any loading condition in elastic-plastic range with due allowance for large plate deflections. Square and rectangular plates were analysed whose geometric and physical characteristics and their division into finite elements are given in Figs 2 and 3. As the loading and de-

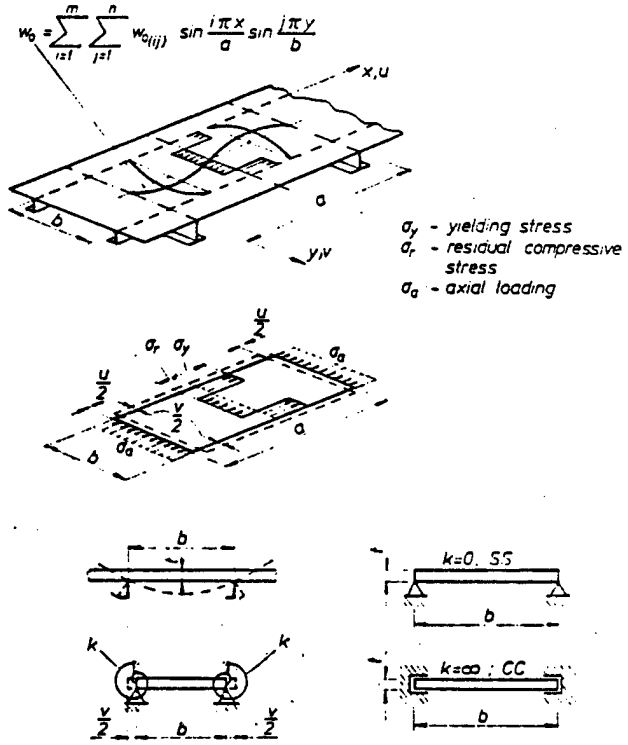
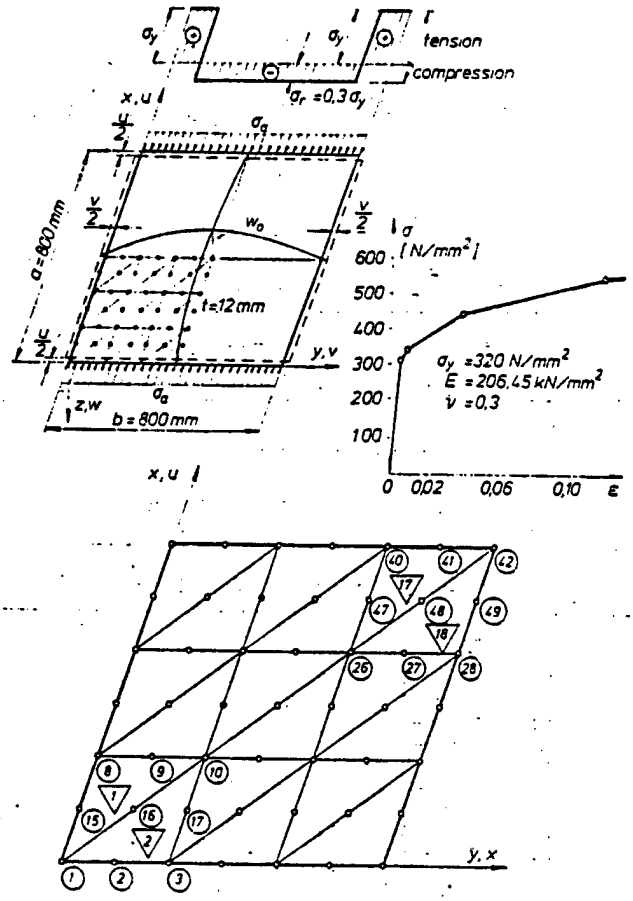


Fig. 1. Axially loaded plate having stresses and deflections and different boundary conditions



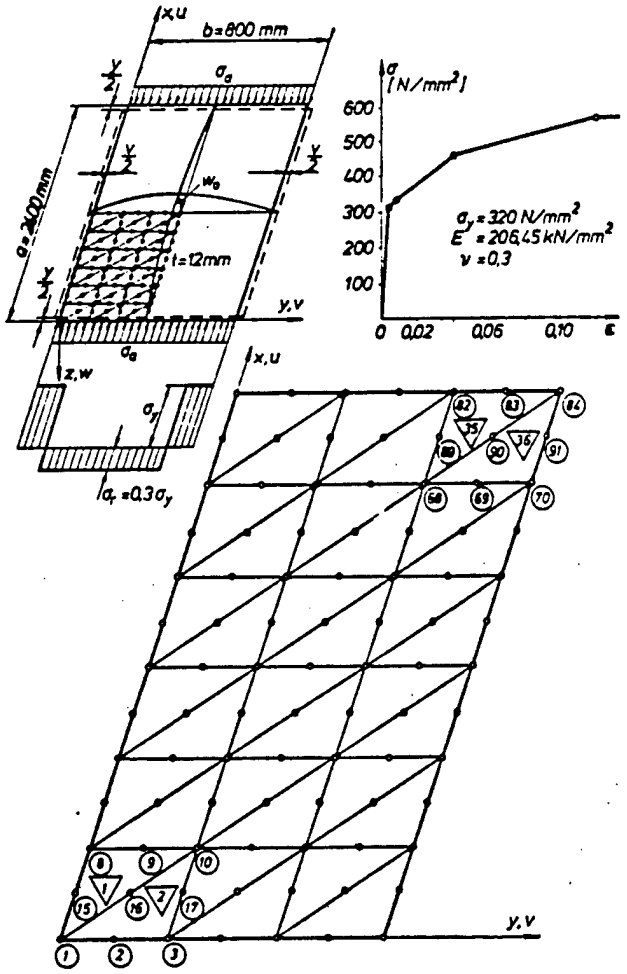


Fig. 3. Computation model of rectangular plates

flections were symmetric only quarters of the plates were analysed. Specification of investigated plates and their characteristics are given in Tab. 1.

CALCULATION RESULTS

Fig. 4 contains calculation results of simply supported square (a/b = 1) and rectangular (a/b = 3) plates having initial deflections but without residual stresses. Initial deflections: $w_o = w_{o(11)} \sin\frac{\pi x}{a} \sin\frac{\pi y}{b}$ — square plates, $w_o = w_{o(11)} \sin\frac{\pi x}{a} \sin\frac{\pi y}{b}$ or $w_o = w_{o(11)} \sin\frac{\pi x}{a} \sin\frac{\pi y}{b} + w_{o(31)} \sin\frac{3\pi x}{a} \sin\frac{\pi y}{b}$ rectangular plates.

Specification of plates and their characteristics

Table 1

Plate number	a/b	Boundary conditions	$\frac{w_o(11)}{t}$	$\frac{w_o(31)}{t}$	σ_x/σ_y
1	1.0	SS; $v \neq 0$	0.3	0.0	0.0
2	1.0	SS; $v = 0$	0.3	0.0	0.0
3	1.0	SS; $v = 0$	0.3	0.0	0.3
4	1.0	SS; $v = 0$	0.05	0.0	0.0
5	1.0	CC; $v = 0$	0.3	0.0	0.0
6	1.0	CC; $v = 0$	0.3	0.0	0.3
7	3.0	SS; $v = 0$	0.05	0.0	0.0
8	3.0	SS; $v = 0$	0.3	0.0	0.0
9	3.0	SS; $v = 0$	0.3	0.3	0.0
10	3.0	SS; $v = 0$	0.3	—0.1	0.0
11	3.0	SS; $v = 0$	0.3	—0.3	0.0
12	3.0	SS; $v = 0$	0.3	0.0	0.3
13	3.0	CC; $v = 0$	0.3	0.0	0.0
14	3.0	CC; $v = 0$	0.3	0.0	0.3

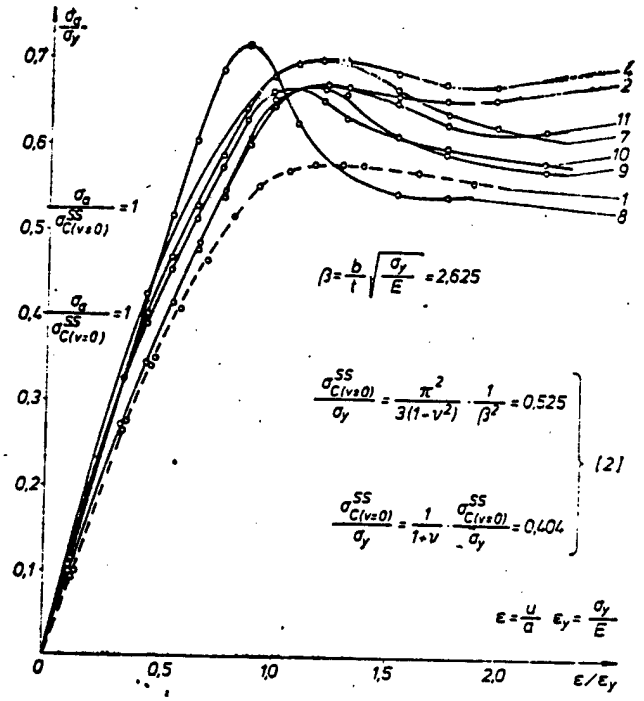


Fig. 4. Load carrying capacity of simply supported square and rectangular plates having very small initial deflections ($v = 0$)

As can be seen in Fig. 4 in case of a square plate an increase of initial deflection in the form of a regular half wave decreases the plate ultimate strength (curves 2 and 4) since in this case the shape of the initial deformation is in accordance with the buckling mode deflection of the plate. The same form of initial deflection increases, however, the load-carrying capacity of rectangular plates (curve 8).

Influence of the aspect ratio a/b on ultimate strength of plates having the same shape of initial deflection has additionally been depicted in Figs 5 and 6. As follows from Fig. 5 there is practically no difference in the behaviour of two almost perfectly flat plates ($w_{o(11)}/t = 0.05$) though one of them is square (a/b = 1, curve 4) and the other rectangular one (a/b = 3, curve 7). This results from the

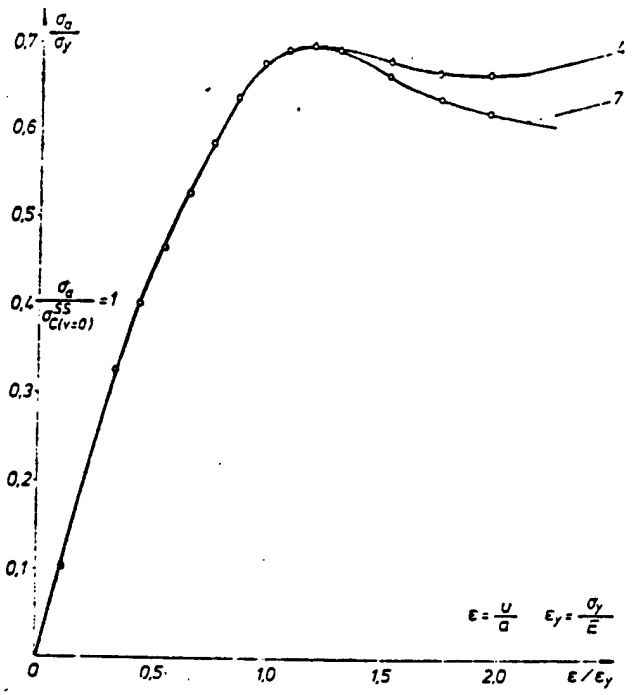


Fig. 5. Load carrying capacity of simply supported square and rectangular plates having very small initial deflections ($v = 0$)

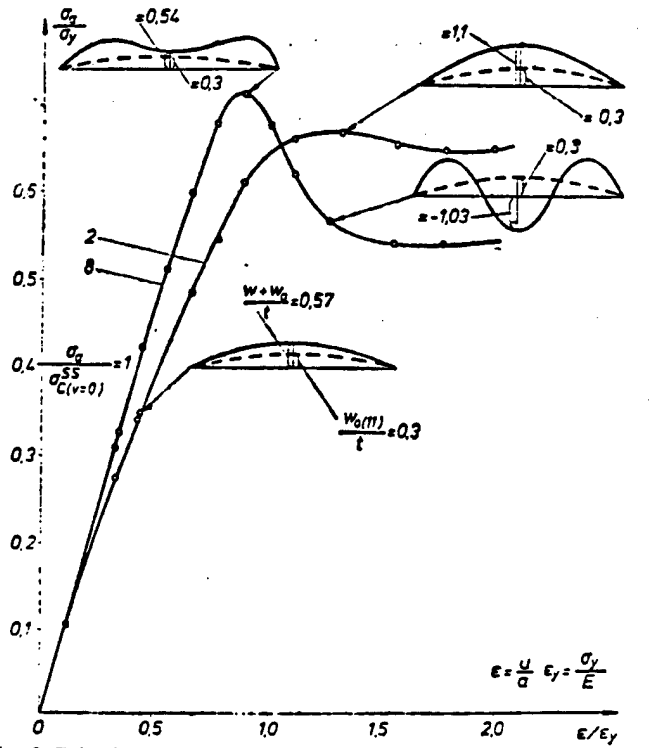


Fig. 6. Behaviour of square and rectangular simply supported plates having the same initial deflections ($v = 0$)

fact that simply supported rectangular plate whose length is three times greater than its width axially loaded along its shorter edges, loses stability in the form of three half waves and so the plate disintegrates into three simply supported square plates with exactly the same state of deflections and stresses in each of them as in a simple square plate. Considerable differences in the state of deflections and stresses appear only then, when both lates are considerably initially deflected but form initial deflection which decreases ultimate strength of the square plate increases the strength of the rectangular one. This results from the difference of the sign of the deflection caused by buckling from the sign of initial deflection in the middle part of the rectangular plate (Fig. 6). Consequently the plate shows an increase of its ultimate strength and at the same time a rapid decrease of it after the maximum load-carrying capacity of the plate has been reached. The latter results from the rapid change of sign of the deflection of the rectangular plate after its peak loading has been reached. This does not take place in a square plate (Fig. 6). A decrease of ultimate strength of rectangular plate can only be expected when its initial deflection contains buckling mode components. There, practically, disappearance of the strengthening effect is observed when the amplitude of the buckling mode component is of sufficiently large magnitude (curves 9, 10, 11). It is also interesting to note considerable influence of displacements of middle planes of plates on the ultimate strength of compressed plates. Complete freedom of such displacements appreciably decreases the plate load-carrying capacity (curve 1). This indicates that a plate being a part of a stiffened flat panel will show appreciably greater ultimate strength than a plate constituting a part of an angle, channel, tee or the like section.

In Fig. 7 the influence of clamping of plate edges on plate ultimate strength has been shown. As could be expected the clamping definitely increases the strength. The behaviour of the plates is then more similar to the behaviour of a disk. Consequently a considerable increase of the plates stiffenes is observed before the maximum loading is reached. The influence on ultimate strength of initial stresses with the distribution given in Fig. 1 can, however, be different; definitely negative when the characteristics of plates are steep (curves 13, 14 and 9, 12,

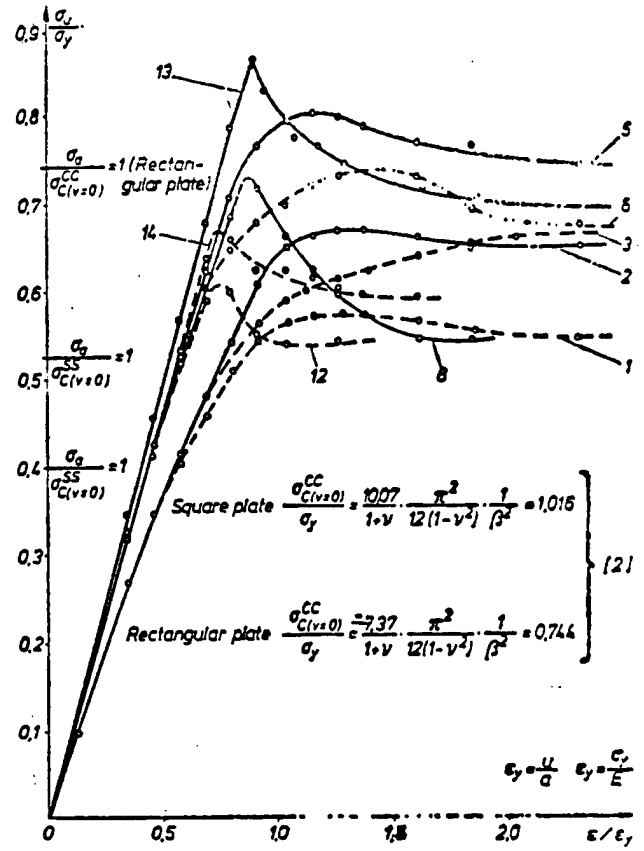


Fig. 7. Load carrying capacity of square and rectangular plates having initial deflections and stresses and different boundary conditions (SS, CC, $v = 0$, $v \neq 0$)

in Fig. 7) or very small or practically none when the characteristics are placid curves 2, 3 and 5, 6 in Fig. 7).

CONCLUSIONS

1. Initial deflections which are in accordance with buckling modes of plate deflections decrease ultimate strength of plates irrespectively of the plates boundary conditions.

2. Initial deflections which are not in accordance with buckling modes of plates deflections increase ultimate strength of the plates irrespective of the plates boundary conditions. At the same time, however, considerably decreases the load carrying capacity of the plates when the axial membrane strains exceed the magnitudes pertaining the peak loadings of the plates (Fig. 6).

3. Characteristics of plates determine the influence of initial stresses on the plate ultimate strength; the influence is definitely negative when the characteristics are steep and very modest or practically none when the characteristics are placid. The former takes place when initial deflections are not in accordance with the buckling mode deflections and the latter when they are.

4. Of essential importance for plates ultimate strength are displacements of the edges of their middle planes. The strength definitely decreases when such displacements exist.

Literatura

1. Jazukiewicz A., Kmiecik M.: Opis programu PLAMES do nieliniowej analizy płyt usztywnionych z uwzględnieniem odkształceń i naprężeń spawalniczych metodą elementu skończonego. Politechnika Szczecińska, Instytut Okrętowy. Opracowanie Nr 37-S, 1981.
2. Bleich F., Buckling strength of metal structures. McGraw — Hill Book Company. INC., 1952.

POLAND

FLAME-SPREAD PROPERTIES OF DOMESTIC, IMPORTED MARINE PAINTS COMPARED

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[Article by Dr. Eng Tadeusz Kukula and Dr Zygmunt Sychta, Szczecin Technical University, Ship Research Institute: "Trade-off Studies on Thermal Properties of Polish and Foreign-Manufactured Decorative Laminates for Marine Use"]

[Excerpts]

Some causes of the interlaboratory divergences relative to the results of testing the characteristics of the surface spread of flame as required by the Register of the U.S.S.R. are discussed. Also the results of testing the characteristics of the surface spread of flame, the fire restistance and smokiness as well as the carbon monoxide emission with regard to the imported decorative laminate PERSTORP FPI and to the Polish decorative laminate UNILAM of the ZBT test run are presented. The possibility of a wide application of the Polish ZBT type UNILAM, product of the Plastics Factory ERG at Gliwice, is stressed.

INTRODUCTION

The fundamental principles, on which the requirements of the fire-fighting regulations of the classification societies (the latest Polish Register of Shipping rules, 1982 included) are based, have been laid down in Regulation 2 of Chapter II-bis of the SOLAS-1974 Convention.

The structural fire protection of ships is integrally connected with a correct selection of the bulkhead and deck constructions as well as with a proper selection of the structural, heat-insulating and outfit materials. Basis of the selection of the constructions in question are the tests carried out for the conformity certification in specialized laboratories recognized by the classification societies [3, 6]. These tests should include, among others:

1) the standard fire test on "A" Class fire-resisting divisions, "B" Class fire-retarding divisions and "C" Class divisions,
2) the incombustibility test on structural shipborne materials,
3) the inflammability test on primary deck coverings,
4) the test for the surface spread of flame — characteristics,
5) the test on smokiness and toxicity of non-metallic materials under conditions of their thermal decomposition.

The results of these tests, confirmed by adequate certificates, underlie the correct selection of the proper constructions and materials already at the stage of ship designing.

The variety of methods of testing, strictly speaking, that of the conditions of measurements, the arbitrariness of the terminological interpretation in the determination of the fire protection usually allows no general comparison

of the degree of fire hazard connected with the application of the given material. When determining the requirements for a measuring system for testing the thermal properties of the materials in order to decide on their fire hazard, it should be taken into consideration not only the reproduction of the fire conditions (e.g. conditions of thermal decomposition and combustion, geometric arrangement of test stand, location of tested material specimens, sources of their ignition) but also the possibility of ensuring the required degree of repeatability of the test results. Among the most important factors decisive of the repeatability of the test results (particularly of the interlaboratory ones) should be classed: **the time-constancy and the reproducibility of the conditions of thermal decomposition and combustion of the tested material specimens** as well as the measuring technique together with the recording of the test results. The fact that these conditions have not been satisfied is usually the reason of serious divergences of the results of the tests conducted in various laboratories.

The attempts of unifying and normalizing these methods on the international scale continually encounter considerable difficulties. In shipbuilding industry the tests itemized: 1,2 and 3 have been normalized on the international scale. The tests on the low flame spread, smokiness and toxicity of the products of thermal decomposition and combustion of shipborne materials depend on the requirements or recommendations of the administrative authorities [3, 6, 7].

METHODOLOGY OF THE LOW FLAME SPREAD TEST

In Poland the low flame spread test on shipborne materials is conducted by a method agreed upon with Polish Register of Shipping [6], the description of which has been presented, among others, in the IMCO FP XII/3 document — Annex 1. Development of this method is the method of low flame spread test according to the requirements of the Register of the U.S.R.R. [7], complemented with further documents [2].

A detailed description of the methods and results of the low flame spread test on numerous materials employed in Polish shipbuilding industry is presented in works [1, 3, 5].

Basis of the classification of the materials is the value of index of the surface spread of flame — characteristics: I, determined by the formula:

$$I = \sqrt{\frac{Q_p}{Q_d} D} \qquad (1)$$

where: — Q_p — heat energy released by the tested material specimen,
Q_d — heat energy delivered to the specimen tested till the moment of its ignition,
D — coefficient of dynamics of the surface spread of flame.

The materials tested are classed on the basis of the mean value of index I:
$I \leqslant 20$ — materials with surfaces of low flame spread,
$I > 20$ — materials with surfaces of high flame spread.

In regard to the smokiness of materials and toxicity of their products of thermal decomposition and combustion the Polish Register of Shipping rules require only that non-metallic materials should emit no excessive amount of smoke and toxic volatile substances. The lack of unambiguous findings in respect of the methods and test results permits of their arbitrary interpretation [5, 8].

The materials manufacturers demand unambiguous criteria of estimation of their products, which would make it possible for them to develop new fire-resisting materials. The manufacturers' justified claims and the divergences of the interlaboratory test results regarding the thermal properties of materials have necessitated trade-off studies to be launched and check tests to be conducted by the Establishment for Ship's Technical Protection of the Ship Research Institute at SZCZECIN Technical University. Some of the results of these tests carried out by this Establishment are presented hereunder.

CONCLUSIONS

1. The methods of testing the surface spread of flame — characteristics, now employed in Polish shipbuilding industry, do not allow, having in mind the ambiguity when determining the parameters of thermal decomposition and combustion of the tested material specimens, their proper estimation from the point of view of the fire hazard which the materials bring about. This causes considerable divergences of the inter laboratory test results.
2. The materials manufacturers are quite right when calling for unambiguous criteria of estimation of their products which should meet the requirements of the relevant regulations binding in shipbuilding. Only in that case the progress and application of numerous home products instead of the imported materials are possible.
3. Till the moment of the resolution of this problem by IMO on the international scale it is advisable to apply in Poland the methods of testing the surface spread of flame — characteristics as well as those of the classification of materials according to the present-day requirements of the Register of the U.S.S.R. to be complemented with the value of heat irradiation intensities of the surfaces of the tested material specimens [2, 5]. In accordance with the assumptions of the method the irradiation intensity of the zero zone of the specimens of wall and ceiling materials, also of tapestry should amount to $32 \div 35\ kW \cdot m^{-2}$ and to $14\ kW \cdot m^{-2}$ for the floor finishes. This version of the method has already been adopted in the COMECON countries for the railway transport.
4. For estimating the serviceability of the shipborne outfit materials the comparative method can be applied, showing that the parameters of the materials tested (e.g. those of the home products) are not worse than the materials adopted as standards (e.g. PERSTORP FPI.
5. The comparative analysis of the test results in respect of the imported PERSTORP FPI and Polish ZBT-type UNILAM shows that the thermal properties of the Polish-manufactured decorrative laminates are similar and in some cases even better than those of PERSTORP FP1 at present imported by Polish shipbuilding industry.

REFERENCES

1. Getka, R.: Criteria of the selection of non-metallic shipborne materials, particular allowance made for the thermal decomposition and surface spread of flame — characteristics. Doctoral thesis. Machine and Ship Building Faculty of Szczecin Technical University. Szczecin 1976 (in Polish)
2. IMCO: Fire test procedure. Submitted by the U.S.S.R., FP XXIV.6/3, 9th January, 1980
3. Kukuła, T., Getka, R., Żyłkowski, O.: Ships' technical firefighting and explosion-proof protection. "Wydawnictwo Morskie" (Maritime Publishers, Co.), Gdańsk 1980 (in Polish)
4. Kukuła, T., Trzeszyński, J.: Air protection of ship's microenvironment. "Wydawnictwo Morskie" (Maritime Publishers Co.), Gdańsk 1978 (in Polish)
5. Kukuła, T., Sychta, Z.: Test for the thermal properties of shipborne outfit materials. Ship Research Institute at Szczecin Technical University. Szczecin 1983 (unpublished)
6. Polish Register of Shipping: Rules and Regulations for the Classification and Construction of Sea-going Ships. Part IV. Gdańsk 1982 (in Polish)
7. The Register of the U.S.S.R.: Rukovodstvo po techniceskomu nadzoru za postrojkov sudov... Cast 5.4. Izd. Transport, Leningrad 1977
8. Sychta, Z.: New method of testing the smokiness of shipborne outfit materials. Doctoral thesis. Machine and Ship Building Faculty of Szczecin Technical University. Szczecin 1979 (in Polish)
9. Quintere, J.: A simplified theory for generalizing results from a radiant panel rate of flame spread apparatus. Fire and Materials, Vol. 5, n° 2, 1981

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